THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

VOL. V (NEW SERIES) FEBRUARY, 1918 No. 2

LOCALIZATION OF FOREIGN BODIES

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IN no aspect of *x*-ray practice has individuality been so pronounced as in the localization of foreign bodies, and the very multiplicity of methods advanced is, of itself, proof of the limitation of all of them. As each operator advances in experience, he will, doubtless, find himself favoring a practice depending much upon the principles here given but differing, perhaps even more, in detail.

ACCURATE DETERMINATION OF THE VERTICAL RAY

The essence of localization is accuracy. Before any attempt is made in the use of localizing devices the location of the focus point must be determined. Upon this location and the ability to determine it rest most of the methods to be described. For this the device shown in Fig. 1 is recommended.

This may be adapted to any standard tubestand with cone attachments, using the cone fitting of that particular stand as a base. In the diagram (Fig. 1) let (*A*) be such cone base; (*B*) a brass or other metal tube with ¼ in. bore except at the extreme upper end where it is reduced to ⅛ in.; (*C*) is a pointer rod, and (*D*) a set screw to hold it in place. It is, therefore, not only a device to accurately center the focus but it serves as well, by means of the pointer, to indicate the point which the central ray will strike. Substituting the attachment (*P*) for the pointer rod we have a plumb

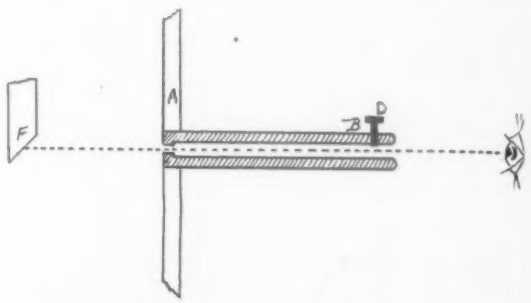

FIG. 1. DIAGRAM OF THE AUTHOR'S TUBE CENTERING DEVICE, POINTER OMITTED.

line with which to discover the course of the vertical ray. (Fig. 2.)

The *vertical ray*, hereafter often referred to, is that ray proceeding from the focus which is perpendicular to the plate or screen. For casual examination, it may be permissible to think of a "central" ray proceeding from the focus to the center of the plate, but for localization this will not do. Even should the focus be so badly centered that no ray from it is perpendicular

to the plate, the vertical ray is still the ray perpendicular to the *plane* of the plate. In any of the following methods which consider the vertical ray as centered upon the center of the plate, it is at once manifest that any degree of failure to meet that requirement must detract just that degree from the accuracy of the result. In fluoroscopy where the tube is confined in a leaded box with a movable diaphragm no less care is needed. A convenient device for this purpose is Fig. 3 made from a piece of brass pipe, 2″ or 3″ in length, set in the center of a wood block 3″ square and 1″ thick. The under side is cut away or rabbeted ½ in. on all sides leaving a shelf by which the device rests on the shutter which is opened to fit it (2 in. square). If the focus is accurately centered the tube will cast a circular shadow on the screen, otherwise the shadow will be oval.

FIG. 2. PLUMB-LINE ATTACHMENT FOR CENTERING DEVICE.

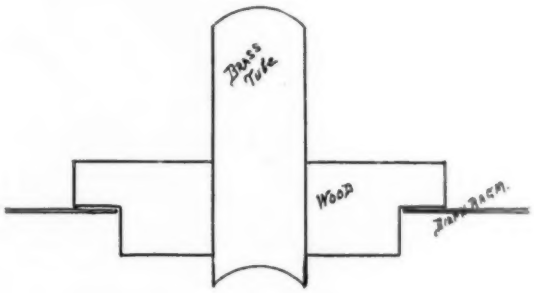

FIG. 3. DIAGRAM OF CENTERING DEVICE APPLICABLE TO RECTANGULAR OPENING DIAPHRAGMS. (CROSS SECTION.)

In all stereoscopic localization the vertical ray or the focus is in the median position, the two exposures being made with rays equally oblique to this perpendicular.

LOCALIZATION BY MEANS OF PLATES

CROSS-THREAD METHOD.—It may be said that all plate methods of localization and many of the fluoroscopic methods depend upon a simple problem of triangulation, which for our purpose may be visualized by means of cross threads, or determined by pre-arranged scales of measurement or measured by rule.

One of the earliest of the graphic methods was that described by Mackenzie Davidson[1] and since known by his name or as the cross-thread method. It consists primarily of a frame by which the two separate positions of the focus and the focus plate distance can be accurately relocated. There are provided also small pointed weights ("mice") to the points of which are fastened threads. In practice two exposures are made upon the same plate from separate positions of the focus, both of which are carefully recorded. The resulting plate bears a double image of all shadows cast by the subject, including a double image of the shadow of the foreign body. The plate is dried and, by the aid of shadows cast upon its margin by an indicator, is placed in the frame in a position exactly corresponding to its position relative to the focus during the exposures. The threaded points are now placed upon the two shadows of the foreign body and the threads are carried to points accurately replacing the two focus positions. If the work has been accurately done the threads will be found to barely touch at a point of crossing and this point shows the distance of the foreign body from the plate.

Slight modifications of the original model

are said to be in active service in British military hospitals to-day. The original and all American derivatives are, however, open to one serious objection for military use. This is, that a localization having been made, the whole apparatus is tied up until that particular foreign body has been removed. This has been quite overcome by Marion[2] in his localizer which is now popular with several operators in French bases. This consists of (Fig. 4) a table (*b*) upon which is a photographic plate (*p*) on which the region of the wound is laid; a graduated column (*t*) vertically fixed on one side of the table; a horizontal semicircular support (*s*) adjustable up and down the column (*t*) and supporting adjustable scales and indicators; another and similar support (*s'*) adjustable in the same way upon column (*t*) but below (*s*), and carrying scales (*r-r'*), vertical indicators (*CC*), and a pointing rod (*g*) adjustable in any direction. The latest models have two of these pointers and a caliper (*h*) for measurements.

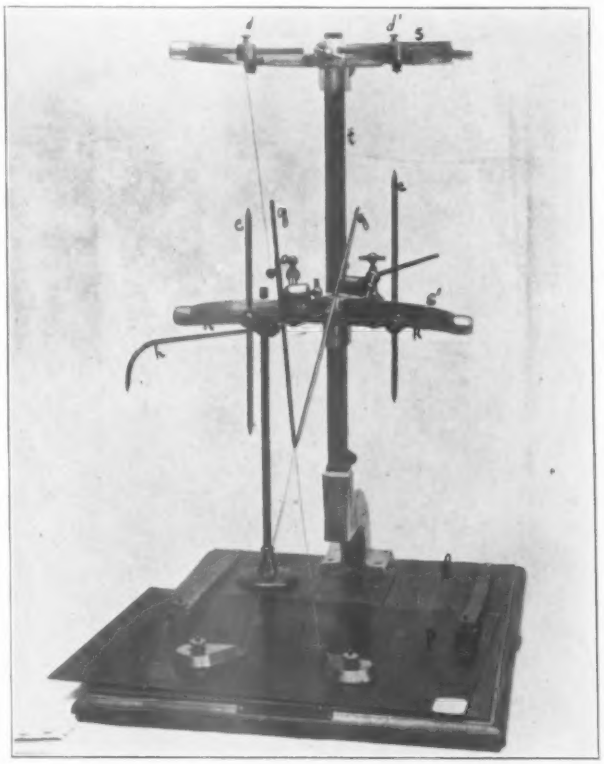

FIG. 4. LATE MODEL MARION LOCALIZER, SHOWING TWO POINTERS AND TABLE CALIPER.

Use.—The region to be examined is placed upon the table in the operating position. The foreign body, approximated by previous examination, is placed as nearly as possible in the line of the direct ray. At a few centimeters distance to one side is placed a lead indicator, as a square with an opening at its center. The location of this marker is permanently marked upon the skin. Vertically above this marker and at a measured distance from the plate the focus is centered and the first exposure is made. The lead marker is then placed an equal distance to the other side. The focus is again centered above it and the second exposure is made.

The distance of each position of the skin marker above the plate is then ascertained with the caliper and recorded.

The negative having been developed and dried we have a plate showing two shadows of the foreign body and one shadow of the lead skin marker in each position. Remember also that in each position this marker was vertically beneath the focus during the exposure, but that the column (*t*) with its attachments was removed.

Reassembling the Apparatus for Operation. — The negative is replaced upon the base in exactly its position during the exposures. Column (*t*) is replaced and the two indicators (*d* and *d'*) made to occupy exactly the positions of the two focal centers during the exposures. The pointed weights (*m* and *m'*) are placed upon the centers of the foreign body shadows and the threads run to (*d* and *d'*). The point of contact marks the altitude of the foreign body. The support (*s'*) is now adjusted and the indicating rods (*C* and *C'*) are made to coincide with the path of the vertical ray for each exposure. These rods will then if projected upward touch, the centers of (*d*)

and (d') and if projected downward will touch the centers of the two skin marker shadows. With the aid of the caliper the lower points of (c and c') are set to the height above the plate of the skin markers as previously recorded. The pointer (g) is now set so that its lower end touches the point of contact of the threads and the rider (1) is set close to the sleeve (o). In later models, two pointers are both so adjusted.

The threads, pointed weights, plate, and, if so desired, the upper support (s) are now removed. The pointer (g) (or both pointers if there are two) is pulled well up into the sleeve (o) taking care that the sleeve is not moved, and the patient so adjusted under the points (c and c') that these points are in exact contact with the permanent skin marks. The pointer (g) (or two) is now lowered until it touches the patient's skin. It then gives the direction in which the foreign body lies and the distance between the lower border of the rider (1) and the upper border of the sleeve (o) is the distance of the foreign body below the skin *in that direction.*

Sources of Error.—Of these the most difficult to eliminate is the question of the exact location of the focus points.

With this localizer, when several localizations are to be made before any of them are operated it is most essential that the various measurements and adjustments be accurately recorded.

Hirtz Compass.—Another graphic method using a widely different application of the triangulation process is the compass of Hirtz [2b].

In Fig. 5 let (R) be the sensitized plate. Upon its envelope is placed a lead marker (V') and upon this is accurately centered the direct ray from focus point (V). The projectile is (P). (A, B and C) are three metal markers at conveniently chosen points on the skin. If the focus is displaced to (F) and to (F'), (Fig. 6), and an exposure made at each point, there will result upon the plate two shadows each of (A, B, C and P).

Knowing the distances (VV') and (FF') we are able, by measuring the displacement in each pair of shadows, to set forth all the data needed for the primary problem.

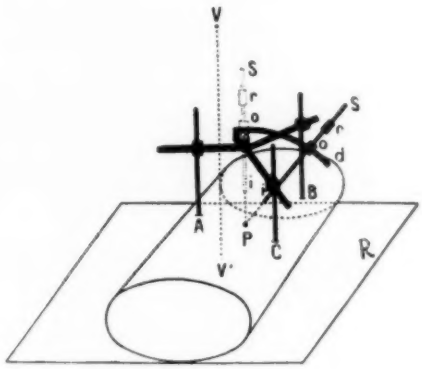

Fig. 5. Diagram of the Hirtz Compass.

Making the Plate.—(1) The approximate position of foreign body should first be determined by one of the fluoroscopic methods.

(2) Upon the center of a plate of proper size place a marker, say a lead triangle (V'). Center the focus accurately above this point.

(3) Being careful not to change position of either tube or plate, place the patient so that, as well as can be judged, the shadow of the projectile will fall a little to one side of the center (V'). The position should also be one desirable for operation.

(4) Choose and mark with lead indicators three convenient skin points to form a triangle, of which the normal ray (VV') shall be the approximate center; not too near together lest they embarrass the operative incision; not too far apart lest their shadows, one or both, be projected outside the plate. It is well to have these markers perforated in the center.

(5) Fix the focus at a chosen altitude (uniform for all cases). Co-efficient tables for 50 cm. and for 60 cm. altitude are supplied with the instrument.

(6) Two points (F and F') are chosen at this altitude which are equidistant from the central line (VV'). This displacement should also be uniform and in most cases is 6 cm.

(7) Two exposures, one at (F) and one at (F'), are now made upon one plate. After development we find a single shadow of (V') and two shadows of each, the foreign body and the three skin markers. These latter should be indelibly marked upon the skin; tattooing, thermocautery, etc., etc.

Graphical Construction.—(*a*) When the plate is dry mark by a point of ink the centers of the shadows of each of the lead markers and of the foreign body.

(*b*) Place a tracing paper over the plate and mark these ink points, as they are seen through, upon it.

(*c*) It will be found that imaginary lines between each pair of shadows will be parallel to each other. Through the point (V') draw a line parallel to these. (Fig. 6.)

(*d*) Upon this line fix the points (FF') by a measurement, exactly the same as the two displacements of the tube. (Another way would be to determine these points before the exposure and to fix opaque markers upon the plate vertically beneath each focus position, exactly as the point (V') was determined in step (2), above.)

(*e*) Mark upon the chart each separate shadow, as for instance (*a*) for the right hand shadow of skin mark (*a* and *a'*) for its left hand shadow. Similarly (F and F') represent respectively right and left positions of the focus.

(*f*) Reciprocally, join by pencil and ruler (*a* to F'), (*b* to F'), (*c* to F') and (P to F') and likewise, (*a'* to F), (*b'* to F), (*c'* to F) and (P' to F).

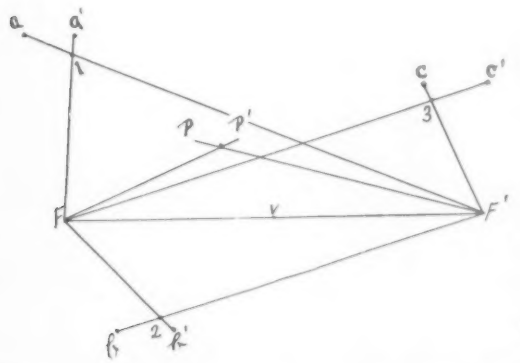

FIG. 6. TYPICAL CHART FOR USE WITH THE HIRTZ COMPASS.

(*g*) At intersection of lines from (*a*-*a'*) mark a point (1), from (*b*-*b'*) (2) and from (*c*-*c'*) (3), and at the intersection of (*P*-*P'*) a dot.

(*h*) Measure with a rule the distances (*pp'*), (*aa'*), (*bb'*) and (*cc'*) which correspond to the spreading of the images and read on a previously calculated table, which accompanies the apparatus, the numbers corresponding to the heights of the different points (P, 1, 2 and 3) above the horizontal plane of the plate. There is a table calcu-

TABLE I

Focus Plate Distance 600 mm.
Tube Shift 60 mm.

Spreading	Height	Spreading	Height
1	10	26	181.5
1.5	14.5	26.5	184
2	19.5	27	186
2.5	24	27.5	188.5
3	28.5	28	191
3.5	33	28.5	193
4	37.5	29	195.5
4.5	42	29.5	198
5	46	30	200
5.5	50.5	30.5	202
6	54.5	31	204.5
6.5	58.5	31.5	206.5
7	62.5	32	208.5
7.5	66.5	32.5	211
8	70.5	33	213
8.5	74.5	33.5	215
9	78.5	34	217
9.5	82	34.5	219
10	85.5	35	221
10.5	89.5	35.5	223
11	93	36	225
11.5	96.5	36.5	227
12	100	37	229
12.5	103.5	37.5	230.5
13	107	38	232.5
13.5	110	38.5	234.5
14	113.5	39	236.5
14.5	117	39.5	238
15	120	40	240
15.5	123	40.5	242
16	126.5	41	243.5
16.5	129.5	41.5	245.5
17	132.5	42	247
17.5	135.5	42.5	249
18	138.5	43	250.5
18.5	141.5	43.5	252
19	144.5	44	254
19.5	147	44.5	255.5
20	150	45	257
20.5	153	45.5	258.5
21	155.5	46	260.5
21.5	158.5	46.5	262
22	161	47	263.5
22.5	163.5	47.5	265
23	166.5	48	266.5
23.5	169	48.5	268
24	171.5	49	269.5
24.5	174	49.5	271
25	176.5	50	272.5
25.5	179		

TABLE II

Focus Plate Distance 600 mm.
Tube Shift 50 mm.

Spreading	Height	Spreading	Height
1	8	26	151
1.5	12	26.5	153
2	16	27	155
2.5	20	27.5	157
3	24	28	159
3.5	27.5	28.5	161
4	31	29	163
4.5	35	29.5	165
5	38.5	30	166.5
5.5	42	30.5	168.5
6	45.5	31	170.5
6.5	49	31.5	172
7	52	32	174
7.5	55.5	32.5	175.5
8	59	33	177.5
8.5	62	33.5	179
9	65	34	181
9.5	68.5	34.5	182.5
10	71.5	35	184
10.5	74.5	35.5	186
11	77.5	36	187.5
11.5	80.5	36.5	189
12	83.5	37	190.5
12.5	86	37.5	192.5
13	89	38	194
13.5	92	38.5	195.5
14	94.5	39	197
14.5	97.5	39.5	198.5
15	100	40	200
15.5	102.5	40.5	201.5
16	105	41	203
16.5	108	41.5	204.5
17	110.5	42	206
17.5	113	42.5	207.5
18	115.5	43	208.5
18.5	118	43.5	210
19	120	44	211.5
19.5	122.5	44.5	213
20	125	45	214.5
20.5	127.5	45.5	215.5
21	129.5	46	217
21.5	132	46.5	218.5
22	134	47	219.5
22.5	136.5	47.5	221
23	138.5	48	222
23.5	140.5	48.5	223.5
24	143	49	224.5
24.5	145	49.5	226
25	147	50	227.5
25.5	149		

lated for a focus height of 60 cm. and one for 50 cm. There is also made a direct reading rule or scale which answers the same purpose.

(*i*) Subtract successively the number expressing the height of (*P*) from those which correspond to the points (1, 2 and 3). These differences are noted and later used in setting the compass for depth. The compass, schematically shown in Fig. 5, has three arms (1, 2 and 3), revolving around a common axis (*O*) through an opening in which there moves, with light friction, a rod (*S*) bearing an indicator (*r*) with set screw. On each arm, in an adjustable rider, and moving perpendicular to the plane of the three branches, there slides a rod having millimeter graduations. A winged nut under the axis of the compass serves to set the branches in a desired position.

Setting the Compass.—(*a*) Place the rod (*S*) in the median position, set the graduation of each of the other rods at zero and loosen the winged screw.

(*b*) Place the transparent paper chart on a small drawing board with the point of the rod (*S*) on the horizontal projection of the foreign body. Place the ends of the other rods on points (1, 2 and 3).

(*c*) Shorten the rods or lengthen them until they stand at the number of mm. found as the difference in distance, from the plate, between each skin marker and the projectile. (Fig. 7.)

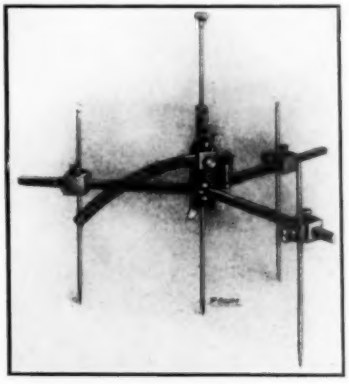

FIG. 7. HIRTZ COMPASS SET READY FOR APPLICATION TO THE PATIENT.

The compass is now ready for use. The patient is removed to the operating table and placed in the position in which the *x*-ray examination was made. This requirement is not too rigid. It is only needed that the rod points shall coincide with three skin marks (Fig. 8). When this condition is fulfilled, the localizing rod (*S*) is lowered to touch the skin. It now indicates the direction in which the foreign body lies and its depth is told by the distance between the lower border of the indicator (*r*)

and the upper margin of the canal in which the localizing rod moves. By means of an arc almost any desired adjustment of the localizing rod may be obtained without resetting the compass. The method is interesting in that the localizing instrument plays no part in the production of the plate, but is set entirely from the plate findings.

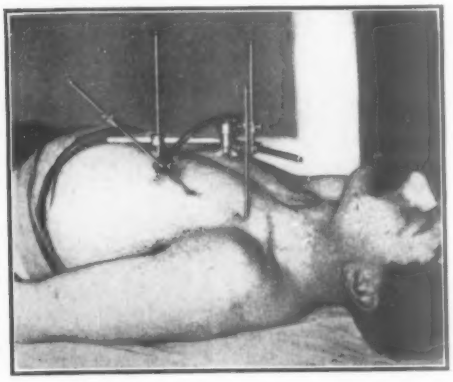

FIG. 8. HIRTZ COMPASS APPLIED TO THE PATIENT.

It must be kept in mind that when two exposures are made on one plate, each exposure should be just one half of the actual exposure time. If two full exposures are made the plate will be too dense for easy reading.

LOCALIZATION BY THE STEREOSCOPE

This is often most satisfactory, the more so if there is real coöperation between x-ray specialist and surgeon. It is most important that sufficient opaque landmarks be provided to produce the stereoscopic effect from the skin surface. For instance the writer has used, for some years past, a paste of lead oxide and vaselin to fill the normal skin markings of the hand and thus utilize the entire palm as a foreground by which needles, etc., may be localized. In larger parts a circle or cross of fuse wire at wound of entrance, a T of the same over a tender point, etc., will add materially to the efficiency. Again, if the foreign body is in close relation to some well-known surgical landmark, e. g., in the glenoid fossa, the stereoscope would give the best information.

Whatever we may concede as against plates for localization they still hold first place, easily, in the *discovery* of smaller fragments and more especially when larger fragments are present in the same field. And when infection is present and removal is sought, for that reason the plate is a paramount necessity in order that the last, even if smallest, fragment may be discovered.

LOCALIZATION BY MEANS OF THE FLUOROSCOPE

In this procedure it is vitally important that the focus point of the tube be accurately centered, and for the same reasons as stated under the plate methods.

With the fluoroscope one can learn very promptly the approximate location of the foreign body with relation to the skin or bones, and therefore the probable point of surgical approach.

Fluoroscopic methods may be classified as immediate or mediate according as localization and removal are combined or separate; and as indirect or direct according as the localization is obtained by the displacement of the shadow in the oblique ray as compared with that in the vertical ray, or by various positions of the body in the vertical ray.

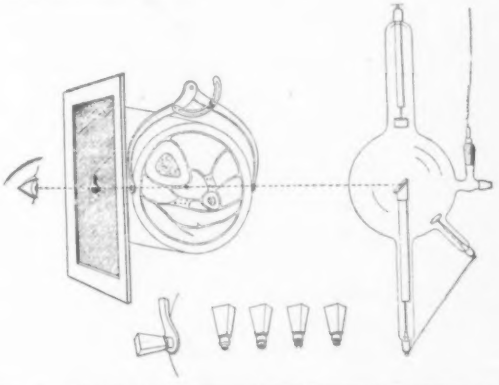

FIG. 9. DIAGRAM SHOWING THE SUTTON CANNULA AND TROCHAR AND THE HARPOON, AS WELL AS THE WAY THEY MAY BE USED.

The milled wing at the head of the cannula may be engaged with a strong forceps and thus obviate the necessity for getting the hands into the open ray.

IMMEDIATE METHODS

Trochar and Cannula.—Of the immediate methods the most important is that of Sutton.[17,18] The following description is given by Flint.[15]

"It is extremely convenient in most cases to have a definite guide to facilitate the search for the projectile during the actual operation. Undoubtedly, the most useful instrument of this type is that devised by Sutton, which may also be utilized as a localizer when the projectiles are situated in the muscular portions of the body. Sutton's localizer consists in a trochar and cannula which is introduced under the skin previously anesthetized by novocain. After disinfection, the operator puts on sterile rubber gloves or manipulates the cannula by means of sterile artery forceps. It is plunged beneath the skin and the sharp trochar is removed from the cannula, which is then replaced by a blunt obturator. The field is covered with sterile towel and the fluoroscope employed. Under the direct vision of the operator, the cannula with its obturator is passed down through the tissues until it touches the projectile. At this point, the light is turned on and the obturator removed. In Sutton's original method, it is replaced by a piece of very fine piano wire with a crochet end. This fine wire serves as the surgical guide to the foreign body. We found, however, that when the field of operation was stained with blood, it was difficult to see the wire, which was also too fine to be felt readily as the operation proceeded into the depths. Accordingly, we substituted a small harpoon, about the diameter of the obturator, which is passed through the cannula, where it opens and becomes fixed in the tissues immediately about the foreign body. After the cannula is withdrawn, the projecting portion of the harpoon is bent over parallel to the skin surface and is covered with a sterile dressing. Thereupon the patient is dispatched to the operating room. This larger guide can be seen with great ease and also felt during the operation, as it leads directly to the foreign body. It is quite obvious, however, that this method cannot be employed except in the extremities or in the muscular portions of the body, owing to the possible injury of important structures. Small nerves and vessels are pushed aside as the cannula and obturator are introduced. The localizer, harpoon, and the method of using them is shown schematically in Fig. 9."

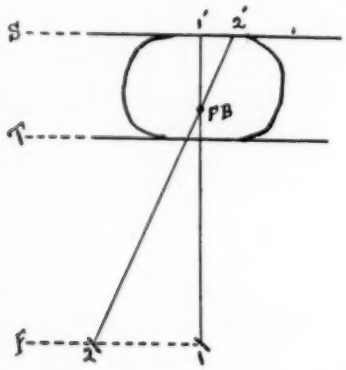

FIG. 10. HARET'S METHOD. DIAGRAM TO SHOW MOVEMENT OF SHADOW WITH TWO POSITIONS OF TUBE.

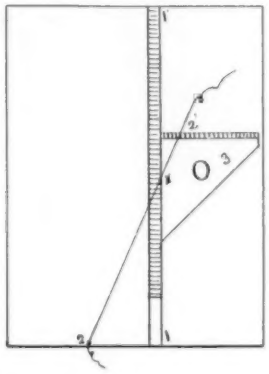

FIG. 11. HARET'S METHOD. THE INTERPRETATION BOARD.

In conversation with the writer, Dr. H. H. M. Lyle states that if at all possible, he undertakes to pass the Sutton localizer in the vertical ray. In this position the head of the instrument hides the point and as soon as the point can be seen it is at once known that the instrument is deviating from the direct course.

Intermittent Control.—Ledoux-Lebard[4] writes enthusiastically of a method which he calls intermittent control. In this the *x*-ray operator wears, during the entire operation, a modification of the familiar hand fluoroscope. This is so arranged that when not in use it can be tipped back over the head, leaving the eyes protected from light by a suitable dark glass.

Working in a light room the patient is placed in suitable position for operation, and the emergence of the vertical ray through the projectile is indicated on the

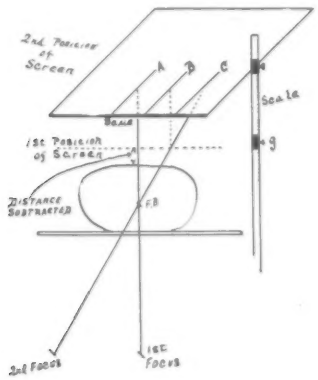

FIG. 12. CARVER'S METHOD.

skin. The incision is made and from time to time the surgeon inserts one of several forms of long-handled instruments, depending upon the distance and position away from direct rays, for his protection. A fluoroscopic observation of this position of the instrument with relation to the foreign body is now made and information given the surgeon from which he proceeds in the same direction as before or in a new direction as the case may be. By this intermittent control the two work, the one operating and the other observing until the body is removed. The value of the method will depend entirely upon the skill which any pair of men may acquire for "team-work."

A serious objection to its use is the lack of protection. The author says that the surgeon is able to keep far enough away, as the tube is never excited while the surgeon is over the wound, and that the *x*-ray

FIG. 13. SHOWING HOW MOVEMENT OF SHADOWS VARIES WITH DISTANCE FROM SCREEN.

specialist has learned to take care of himself.

INDIRECT METHODS

In the indirect methods one plots the depth of the foreign body from the point on the skin where the vertical ray exits after passing through the foreign body. Many modifications of this principle are described in recent literature.

Simple Tube-shift.—Haret's method[12] also described by Gocht[13] is perhaps the simplest of this class. In Fig. 10 let (*S*) be the screen, (*T*) the table, and (*F*) the focus. The distance (*FT*) and the distance (*TS*) are measured and recorded. Practically (*FT*) is usually fixed, i. e., the same for every case, while (*TS*) is found upon a graduated upright attachable to table, or by actual measurement. The shadow of the foreign body is located in the vertical ray, the entrance and exit of which is marked, as in

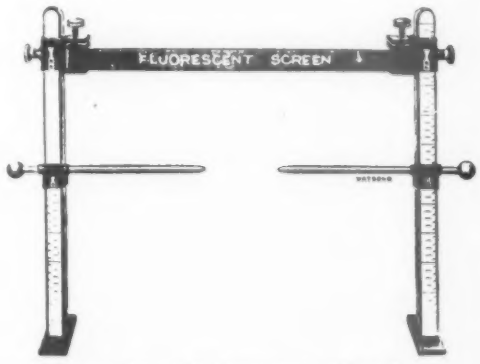

FIG. 14. JORDAN'S LOCALIZER, END VIEW.

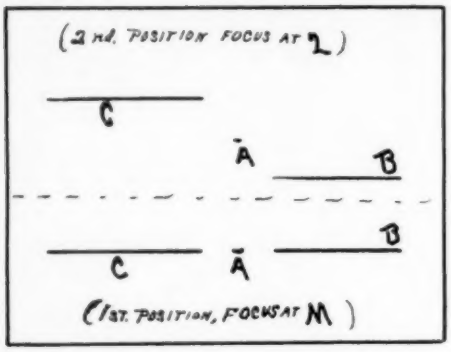

FIG. 15. JORDAN'S METHOD. APPEARANCE OF IMAGE FOR TWO POSITIONS OF THE TUBE WHEN RODS AND FOREIGN BODY ARE AT DIFFERENT LEVELS.

other methods, upon the skin. It is also marked upon the screen, using either the pierced screen or greased pencil. The focus is now shifted from (1) to (2), a measured distance, say 15 cm. The shadow on the screen will, of course, shift also from (1′) to (2′). This distance is measured and noted.

We now have recourse to a drawing board (Fig. 11), or any plane surface of suitable size (the scale may be permanently laid out on one of the walls of the room) in the center of which is a scale with cm.

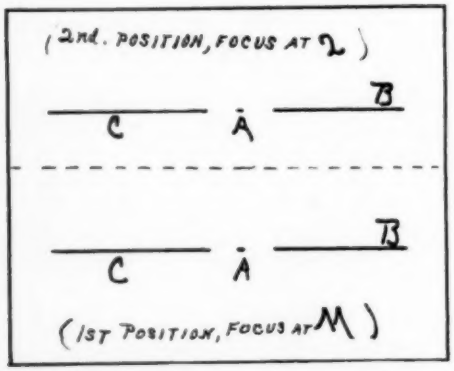

FIG. 16. JORDAN'S METHOD. APPEARANCE OF IMAGE FOR TWO POSITIONS OF TUBE WHEN RODS AND FOREIGN BODY ARE IN SAME LEVEL.

graduations (1-1′), with a straight edge to fit a triangle (3) also graduated in cm. The triangle is now set against the vertical scale at a distance equal to (*FS*) (Fig. 10). A small nail is set in the drawing board at (2) to which is fastened a thread, the distance (1-2) being equal to the focus shift distance (Fig. 10). On the graduated triangle is now read the distance (1′-2′) of the shadow shift as seen on the screen (Fig. 10). The thread is now drawn straight and will cross the vertical scale at a distance, below the corner of the triangle, equal to the distance of the foreign body below the screen. The distance between the screen surface and skin must be deducted, which gives the depth of the foreign body from the skin.

Carver's Method.—The method described by Carver[10] does not require measurement

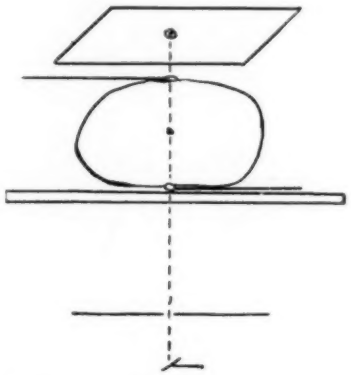

FIG. 17. DIAGRAM TO SHOW USE OF RING POINTER. TWO SUCCESSIVE POSITIONS IN WHICH THE POINTER IS PLACED.

of the focus-screen distance nor that of the focus shift. The screen is fitted to an upright which is graduated and provided (Fig. 12) with a glider (*g*). In the first position the screen is lowered to touch the patient. (If it does not touch the distance from the skin must be recorded and calculated in later.) The glider is raised until it is in contact with the screen holder. Manipulate until the foreign body shadow is in the vertical ray as described above and mark both its entrance and exit upon the skin. Now move pointer (*A*) (attached to screen) along the scale on the screen until it marks the shadow. The focus is now moved any convenient distance and pointer

FIG. 17A. THE RING POINTER.

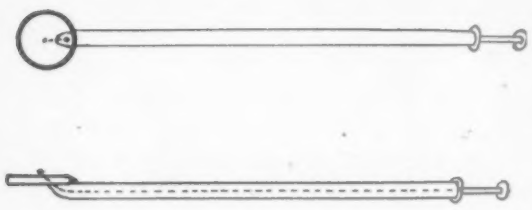

FIG. 18. AUTHOR'S RING POINTER AND MARKER COMBINED.

Front and lateral views. In both the Bowden cable is shown as pushed out to its marking position. At rest it is withdrawn well below the level of the ring.

(*B*) is moved to mark the new position of the shadow. Pointer (*C*) is now set at the same distance from (*B*) that (*B*) is from (*A*). The screen is raised until the shadow is shifted to (*C*). At this point read on the scale of the upright the distance that the screen has been raised above the glider. This equals the distance of the foreign body below the screen in the line of the vertical ray previously marked. If the screen did not rest on the skin at this point the distance between them must be subtracted from the reading.

Equal Shadow-shift.—Jordan's method[11] is based upon the fact that, given a surface (*s*), an object (*o*) and a distant light (*L*) movable in a plane parallel to (*s*):—then, the shadow of (*o*) will move proportional to its distance from (*s*) or inversely as its distance from (*L*). In the diagram Fig. 13 let (*A*), (*B*), and (*C*) represent three bodies in the same vertical plane but in different horizontal planes. With a source of light at (*M*) the shadows (*C*, *A* and *B*) will be cast in a straight line (vertical to the plane of the diagram) at (*M'*). But if the source of light be shifted to (1) or to (2) the shadow of (*C*) will move more and that of (*B*) less than that of (*A*).

Now transfer the same letters with the same significance to Fig. 15, a diagram of a fluorescent screen. (*A*) is now the foreign body, (*C*) is a rod in the same vertical plane but at a lower level, (*B*) is a rod in the same plane vertically but at a higher level. With the light at position (*M*), the vertical ray, (*A*, *B* and *C*) are in line, but in position 2 (the focus having shifted toward the reader) the shadow of (*B*) has moved less than that of (*A*) while that of (*C*) has moved more, therefore (*A*) is farther from the screen than is (*B*) but nearer than (*C*).

In Fig. 16 the rods have been so maintained upon their uprights that in both position (*M*) and position (2) the shadows are all in line, therefore both rods and foreign body are at same distance from the screen. This method should be of value especially with patients so seriously injured that turning is undesirable. It will naturally increase in difficulty with increase in size of the part examined and consequent greater separation of the rods.

Fig. 14 is an end view of Jordan's apparatus.

DIRECT METHODS

All direct methods depend upon some means which mark the point at which the vertical ray passes through the skin both at entrance and exit. The earliest, most simple, and, so the writer thinks, best of these was described by Morize[7] and many

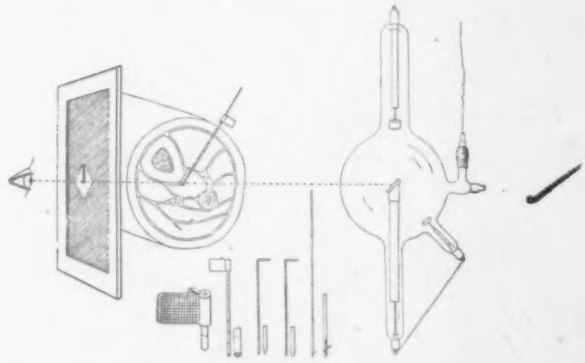

FIG. 19. DIAGRAM SHOWING THE USE OF THE FLUOROSCOPE AND THE RING COMPASS TO OBTAIN THE DIAGONALS PASSING THROUGH THE PROJECTILE AND THE STAMPS TO MARK THEM ON THE SKIN.

others. It may be called the ring pointer (Fig. 17). In use the foreign body shadow is first located on the screen and then the diaphragm opening shut so that a very small zone of lighted screen surrounds this shadow. The ring is then passed beneath the patient and so manipulated that the shadow of the ring surrounds that of the

FIG. 20. VERGELY'S METHOD. FORMATION OF CARD.

foreign body. This point is marked and the ring is removed. Without moving tube or patient the same procedure is undertaken with the ring *over* the body and again the point is marked. The patient is now turned, and with tube and diaphragm in the same position a second pair of marks is secured. Three or even four pairs tend to still greater accuracy. By marks either of distinctive color or of distinctive shape each pair should be made easily distinguishable from every other pair. The accurate marking of such points as occur on the under aspect of the patient may offer some difficulty. Following a suggestion[8] the writer has devised an instrument which may perhaps be original to the extent that it combines the ring and the marker. This consists (Fig. 18) of a ring fitted to a tubular handle which carries a Bowden cable. (The original model made use of an ordinary shutter release such as are commonly used on amateur cameras.) This cable carries at its distal end a minute bit of cotton saturated with copying ink, and is so directed that a thumb pressure will project it into the middle of the ring. The marking .thus is made accurate and rapid. The writer prefers a set of four, each inked with a distinctive color. It need hardly be said that such marks are most temporary and must be replaced with others more prominent before the patient is even moved from the room. For this purpose Ledoux-Lebard uses either the thermocautery or a tattooing instrument; but unless the removal is to be long delayed it seems that solid silver nitrate should be quite sufficient. An elaboration of the ring pointer is found in the ring forceps or calipers described by Belot[9], and modified by Flint. In this instrument (Fig. 19) the upper and lower ring are combined and so manipulated over and under the patient that both ring shadows appear as one about that of the foreign body.

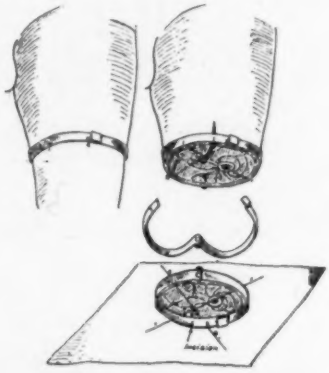

FIG. 23. DIAGRAM SHOWING HOW THE PROFONDOMETER IS EMPLOYED TO MAKE CROSS SECTION CHARTS AND ITS USE IN INDICATING THE EXACT POSITION OF THE INCISIONS.

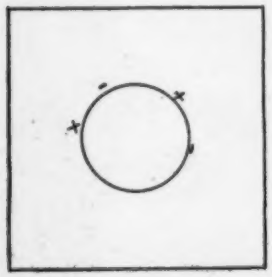

FIG. 21.

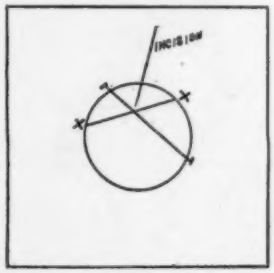

FIG. 22.

FIG. 21. VERGELY'S METHOD. DISTINCTIVE MARKS TRANSFERRED TO CARD.
FIG. 22. VERGELY'S METHOD. COMPLETED CHART.

REPORTING TO THE SURGEON

Localizing methods may be ever so clever, but if we fail to transmit their information to the surgeon so that he actually extracts the foreign body from that information, then there is a fault somewhere. It is perhaps as often a failure to translate

the findings into a form that the surgeon readily grasps as it is a fault of the method.

In the case of the indirect methods the information gained is that the foreign body is at a definite depth from a spot marked on the skin. The line from the skin mark to the foreign body at the time of localization is a perpendicular, but if the patient is rotated the line will become oblique. It is therefore important that the position of the patient at the time of operation should be the same as at the localization.

Cardboard Cut-outs.—The direct methods may be reported graphically as follows: We have four, six, or eight marks upon the skin grouped in pairs, each pair representing a line passing through the foreign body,

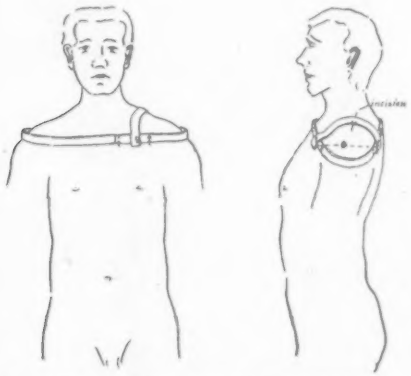

FIG. 24. USE OF TWO PROFONDOMETERS AT RIGHT ANGLES TO EACH OTHER.

and, if accurately placed, all will be in a regular line encircling the part. The separate marks should be permanently marked, as, for instance, with solid silver nitrate, and the encircling line may be less permanent, as with writing ink. We may now employ the method of Vergely [14] (Fig. 20). In a plain card of suitable size an opening is cut to fit the wounded region at the level of the skin markings. These markings are then transferred to the margin of this opening (Fig. 21) using in this instance distinctive signs, the + and the —. A better method is the use of distinctive colors. The card is now removed and laid upon a sheet of paper on which the margin of the opening is traced as are also the distinctive marks. These marks are now connected

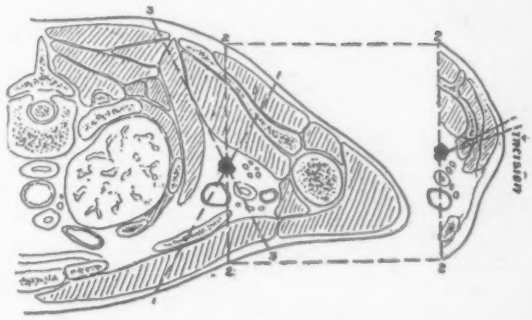

FIG. 25. HORIZONTAL AND VERTICAL SECTIONS INDICATED BY FIG. 24.

by pencil lines + to + and — to — or red to red and blue to blue, etc. (Fig. 22).

The Profondometer.—Another method is by the use of flexible metal strips. During the present war this has rapidly gained in general favor but was first recorded by Flint [15] and by him credited to Irwin and by them named the profondometer. It may be made of any flexible material which has yet enough stability to retain its shape when carefully handled. The writer prefers block tin from 1/16 to 3/32 in. thick and from ½ to 1 in. in width. Two pieces are hinged end to end and are made of suitable length for the parts to be examined, somewhat more than one half the circumference of the arm, thigh, or torso as the case may be. These are now moulded about the part at the desired level, taking care to place the

FIG. 26.

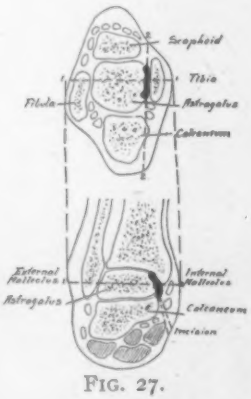

FIG. 27.

FIG. 26. USE OF TWO PROFONDOMETERS ON THE FOOT.
FIG. 27. HORIZONTAL AND VERTICAL SECTIONS INDICATED BY FIG. 26.

hinge in a favorable position that the instrument may be removed without disturbing its shape. The point of overlap is marked and the distinctive marks are transferred in exactly the same manner (Fig. 23) as described for Vergely's card, and in a like manner the paper chart is made. The further procedure is described by Flint as follows:

"The profondometer is thereupon removed from the paper and the corresponding points are converted into real diagonals by a ruler, so that we have the exact position of the projectile indicated at the point where the lines intersect. Finally, the important anatomical structures can be sketched into the cross-section, a procedure which is greatly facilitated by the aid of a good cross-section anatomy like that of Eyclesheimer, and Shoemaker, for example. It is now possible with these data to

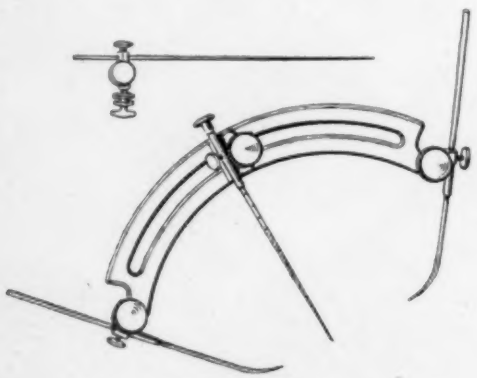

FIG. 28. DEBIERNE'S COMPASS.

plan the operation and select the incision with reference to surgical and anatomical considerations, which is then marked on the tracing. By means of the profondometer, the position of the incision can be transferred to the skin surface of the body by first marking it from the tracing on the instrument and then replacing the latter on the body in its original position and making a corresponding mark on the skin. The tracing may then be used to obtain exact measurements from the incision to the projectile. The various stages of the application of the profondometer and the

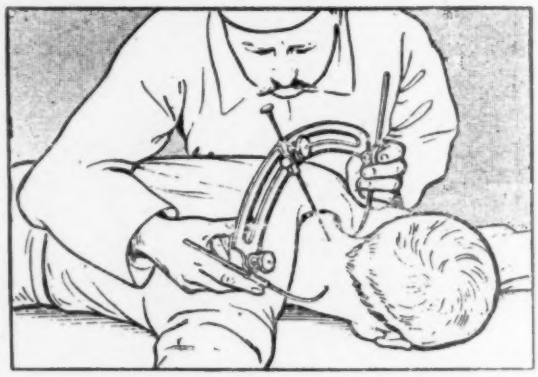

FIG. 29. APPLICATION OF DEBIERNE'S COMPASS.

method of obtaining the tracing are shown in Fig. 23. It is important to remember in obtaining cross-sections of large regions of the body, like the chest or abdomen, where there may be some distortion of the profondometer from the spring in the metal which might lead to a slight error, that it is well to control the anteroposterior and lateral diameters of the section under examination. This is done most easily by checking up these dimensions as the profondometer is placed on the paper. There are certain parts of the body where a simple horizontal localization sometimes does not give the data necessary for extraction, owing to the interposition of bony structures, and in these cases the method must be modified. Such an instance occurs, for example, where a shell fragment lies between the clavicle and the scapula adjacent to the brachial plexus and axillary vessels. As the only operative route lies above the shoulder, this fact necessitates the addition of a right angled or vertical localization, starting

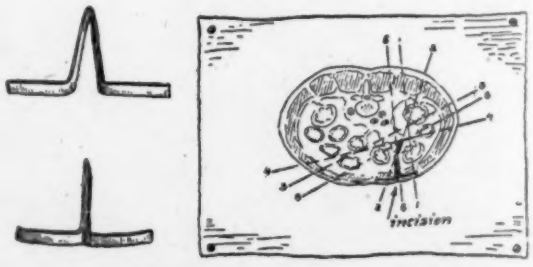

FIG. 30. A BAND GUIDE AND ITS APPLICATION TO THE ABDOMEN.

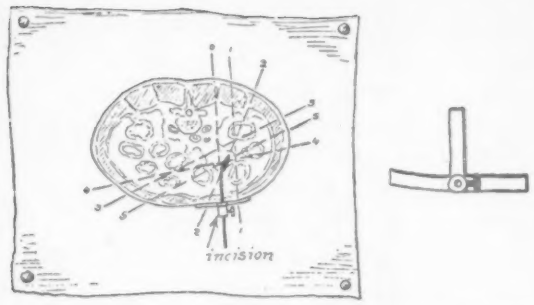

FIG. 31. TRIPOD BAND GUIDE AND CHART TO ACCOMPANY IT.

from one of the original diagonals as a base line. I solved this problem by placing a malleable band of metal similar to the profondometer and moulding it to the shoulder in a position at right angles (Fig. 24) to the ends of one of the diagonals. This diagonal is then projected out to one side of the chart (Fig. 25) and the vertical contour of the

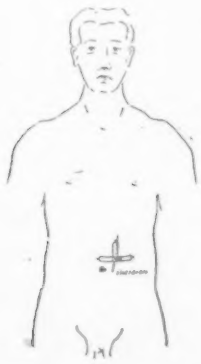

FIG. 32. APPLICATION OF TRIPOD BAND GUIDE TO THE ABDOMEN.

shoulder obtained by a tracing of this second piece of moulded metal. This makes it possible to obtain accurate measurements from above and to select the proper incision from the surgical point of view. Another similar problem is presented by the case where a shell fragment lodged between the internal malleolus and the astragalus. This patient had been operated upon unsuccessfully in another hospital. The horizontal localization shows the interference of the malleolus with the selection of a direct incision, which should of choice be from below. By the use of a secondary band extending below the sole of the foot, as is shown in Fig. 26, not only the incision, but accurate measurements from it to the shell fragment are obtained. The charts with the right angled localization are given in Fig. 27. It can readily be seen that, with similar variations of this method, there is not a part of the body which cannot be rendered accessible and for which data for the extraction of projectiles cannot be obtained."

Guiding Instruments.—Not infrequently the surgeon feels the need of some tangible guide as an added assurance that the chart is being accurately used. Such is the compass of Debierne[16] the use of which is easily understood from Figs. 28 and 29. The bar is an arc and the pointer may be shifted at will without resetting the compass.

A much simpler device for the same purpose is described by Flint as follows:

"To provide an operative guide for abdominal and chest cases or those with projectiles in the neck, where the Sutton localizer would be dangerous, a band guide was devised and used. This is made as follows: A small band of aluminum is bent double. It is then placed on the tracing (Fig. 30) with the bend at the position of the projectile extending in a straight line through the selected incision. At the skin level, the two arms are bent to conform to the skin contour. In this way, after the incision is made, the guide can be slipped into the wound and, when the proper depth is obtained, it should touch the projectile. As there is, however, certain possible inaccuracy in this instrument owing to the fact that the indicator can swing through the arc of a circle, a tripod guide and pointer were devised as an improvement. This is moulded to the skin contour from the chart (Fig. 31) with the socket of the pointer lying in the plane of incision. It is then placed in the corresponding position upon the patient and three marks made upon the skin at the ends of the tripod (Fig. 32). The tripod is then replaced upon the chart and

the pointer inserted and adjusted so that it reaches the depth of the projectile, where it is fixed in position by a thumb screw. Obviously, when this is utilized during the operation, the three marks upon the skin will always control the position of the pointer so that it leads directly to the foreign body. While these various guides are very convenient during the actual period of the operation, they are not absolutely essential. As a matter of routine, it has usually been our custom to utilize them, particularly the Sutton cannula and harpoon, in conjunction with the charts, because they facilitate and simplify the operation. Moreover, there is an additional factor of safety in utilizing one method to check the possible errors of another."

[EDITOR'S NOTE.—In the foregoing article we find several instances where the names of authors have been attached to the methods which they have described, even though the authors themselves have disclaimed any intention to hold the methods as original. For instance, Jordan specifically states that the method he has employed was already in use by Shenton. Haret disclaims originality for the method attributed to him. Flint himself calls attention to the fact that malleable bands were used before him by Warluzel and Jollant.

In order to place before our readers, for future reference, a list of articles on foreign body localization, there will be published in the March issue a collective review on the subject, beginning with the earliest publications of March, 1896.—J. T. C.]

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Especially is indebtedness acknowledged to the masterly monograph of Ombredanne and Ledoux-Lebard, and to Dr. Joseph Marshall Flint for very kind permission to make unrestricted use of recent articles.

THE WAR ROENTGENOLOGIST IN HOME TERRITORY

BY C. B. HOLLINGS, M.D.

Major Medical Reserve Corps, U. S. Army.

FT. LEAVENWORTH, KAS.

THE last six months seem like a dream to many physicians. Men who were following the regular duties of civilian medical practice were summoned to army life and the difference is as great as that between a clergyman in a country town and a traffic policeman on Fifth Avenue. What roentgenologist would have imagined that he was to undergo the paring-down process of the training camp, with its hikes, setting-up exercises and early hours? Nevertheless, many have survived these things and look back at them with even some pleasure and satisfaction.

The early summer found many physicians of the Officers' Reserve Corps eyeing telegrams from Washington which ordered them to proceed to a training camp. My surprise at the first enlisted man's salute, the quandary about the parts of the uniform and the proper honors and ceremonies, were probably the experiences of other reserve officers. It has been said that at least one doctor reported at Fort Benjamin Harrison ornamented with a sabre and shortly after inquired for his orderly who was to polish or rather "police" his shoes and run his errands.

A part of the barracks at Fort Benjamin Harrison was erected for a training camp for the medical officers, while the remainder housed several thousand student officers. Each of the four medical companies of about one hundred men was commanded by an officer of the regular medical corps who acted as instructor. Each company was furnished with two sleeping barracks and a mess hall with the kitchen at one end. The only formality of the day which did not require the premonitory whistle of the top sergeant occurred when the colored boys stood by to unlatch the mess-hall doors at meal times.

The companies began the day's work with roll call at half-past five in the morning. This was preceded by as much time as each individual desired. One showed by his calm demeanor and well groomed appearance that he believed in preparedness. Another indicated by his hasty exit into the company street at the last minute that he had not yet become adjusted to his changed habits. After the top sergeant had made his report, the company joined the others in battalion formation for the setting-up exercises. It was an amusing and pathetic sight to see the men of that particular profession which advocates hygiene in its various forms at this drill. It is not necessary to sketch the picture further. The rest of the morning after breakfast was taken up with road work, foot drill, map sketching, tent pitching and ambulance or litter drill. In the afternoon, classroom work filled the hours until five o'clock.

The question has been debated many times as to whether or not the doctor with special medical training and ability should undergo the course of "right face," "litters post" or "pitch shelter tents" of the camp as well as the other requirements of the drill. The answer to this is clearer to the man who has been through the training than to the one who theorizes about it. The new officer has entered into military surroundings and should know what is expected of him as well as what to expect of others. He will be in command of a group of men who in turn have had military training and who know that certain requirements have been established for them. How, then, can he obtain the clean-cut results in his work, unless he knows what to do and what should be done by others?

It may be necessary in an emergency for the officer to take command of troops.

The sense of *de profundis clamavi* would then come home to him in full force in his helplessness. In reality, he is in the way if untrained in army routine. Moreover, let it be slyly mentioned that a little discipline, out-door living, and regular exercise for untrained muscles will benefit him.

The average age of the men at this medical camp was about forty years and seventy per cent. were married. No other branch of the army can show greater patriotism.

For the roentgenological division, men were selected who were fitted for the work by previous training. For further instruction, schools of war roentgenology were established in several cities, as Boston, New York, Kansas City, San Francisco and others. Members of the American Roentgen Ray Society were commissioned by the War Department to act as instructors. At the end of the three months' intensive training in practical work, demonstrations and lectures, the men found suitable were assigned to base hospitals or cantonments. War roentgenology is, in a way, a specialty within a specialty. The classes are drilled in the wiring and mechanics of the machines and the ways of locating and correcting difficulties. In times of stress "over there," the electrician may not be available. The operator must also be conversant with the numerous methods of locating foreign bodies and to this end each school was furnished with wax anatomical parts in which were imbedded bits of metal for localization. Accuracy and speed with the fluoroscope are especially sought for and localization methods which require calculation may be passed by, when twenty-four hundred cases are brought in from the front within sixty hours, as occurred at one base hospital.

Eventually orders arrive for the men at the schools to depart, and each with his goods, chattels and swagger stick sets out for his assignment with more *sang-froid* than when he first donned his uniform. After his respects have been paid to his new commanding officer, he investigates his quarters and laboratory. The standard equipment is found to be the transformer, fluoroscopic table, vertical fluoroscope, vertical plate changer, eye localizer and Coolidge tubes with tube stand. The work is similar to that of a general hospital where fracture and dental work together with chest examinations take the first place.

There is very little social life at the cantonments. On a half holiday there is an exodus of officers from the camps and the enlisted men load down the army trucks even to sitting on the hoods and fenders. The provisional officers are occupied with evening lectures and studies during the week, so that, if they are fortunate enough to be situated near an active town, the occasional hotel fare and moving picture show makes an agreeable break. In the day time, companies are drilling on all available open spaces and from the distant rifle range come the sounds of target practice. In the new buildings under construction, the numerous workmen find opportunity to practice *camouflage* on their own behalf. Everywhere, the spirit of accomplishment is apparent, and all are pressing toward the desired objective.

THE ROENTGEN DIAGNOSIS OF BONE LESIONS

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JOHNSTOWN, PA.

THE roentgenogram is not a picture of disease. It is a record only of varying resistance to the passage of the ray offered by the parts roentgenographed. For example, the semi-solid liver-like substance in sarcoma, the blood-stained fluid in bone cysts and the pus in bone abscesses often cannot be differentiated by means of the roentgen ray alone, because penetration depends upon specific density which in turn depends upon the atomic weight of the elements of the substance. The interpretation and meaning of various shadows in bone lesions, whether they are caused by pathologic conditions or not, require, on the part of the roentgenographic diagnostician, a full knowledge of the clinical expressions of the various affections and of the various shadows in consequence thereof.

A case of osteomyelitis of six to eight weeks' standing, as the case shown by Fig. 1, presents a characteristic picture. The mottled appearance on the plate, alternating dark and light areas, with rarefaction, indicating bone softening and loss of lime salts extending from the epiphyseal line downwards with no epiphyseal involvement and showing the new bone formation at the periphery, is practically pathognomonic of osteomyelitis. In the case shown by Fig. 2, a more virulent type of infection of only five days' duration, the roentgenogram reveals softening of the cancellous structure of the lesser trochanter shown by the absorption of the lime salts in this area; also the shaft of the bone is darker than that of the opposite femur. This is due to the surrounding pus beneath the periosteum giving a similar effect to the blood found between the periosteum and bone in scurvy. This was confirmed by operation. A culture from the pus obtained was found to be nearly a pure streptococcic strain. In acute osteomyelitis, the infection is at first located in the medulla. When the pyogenic infection is very virulent, rapid and extensive, as case represented by Fig. 2, it causes blockage of the vessels, not only of the medulla, but also of the shaft, producing necrosis. The main nutrient vessels of the bone are thrombosed, but due to separate blood supply of the epiphyseal ends and the periosteum these are not affected. The roentgen ray has its limits in the diagnosis of early cases of osteomyelitis because changes in structure (density) of the bone has not been produced. The diagnosis must be made by means of the clinical signs and symptoms, not relying on the roentgen findings in early cases.

Fig. 3 is a case of osteomyelitis six months after seven inches of the shaft of the bone was removed. As much of the periosteum as possible was left. Fig. 4 is the same case two years after operation. The regeneration of bone by the direct division of osteoblasts is well shown in the upper fragment and ossification proceeded rapidly, due to the favorable condition of the case. The periosteum normally contains few or no osteoblasts, but if certain stimuli be applied to the underlying osseous tissue, we find the osteoblasts are increased in the Haversian canals and are found to accumulate in the subperiosteal areolar tissue surrounding the area of irritated bone. Osseous production ensues to an extent limited by the osteoblastic supply, as shown in this case from the lower fragment extending upward.

Bone abscesses are readily detected on a roentgenogram and are seen to be of a large size (larger than a hazel nut). They have but little density in their center, but

FIG. 1. OSTEOMYELITIS OF THE TIBIA, SIX WEEKS' DURATION.

Showing marked disturbance of the shaft, due to necrosis and new periosteal bone formation. No involvement of the epiphysis.

are surrounded by a wall of considerable density. These abscesses are usually due to an infection in the spongy tissue. When old or of long standing, they may be surrounded by a dense eburnated wall. If of great extent, we may find a network of trabeculæ extending through the entire area. When this occurs, differential diagnosis, with some bone lesions to be later described, is very difficult.

Post-typhoid lesions of bone sometimes occur at long intervals following typhoid fever. The "collar stud abscess" is typical. Here we have an increase of the compact layer of the affected bone with a corresponding narrowing of the medullary canal. In other cases, the periosteum is principally affected and there is a tendency to necrosis of the underlying bone. When it affects the spine, the vertebræ are not well defined, but there is no absorption of the intervertebral discs as in tubercular lesions of the spine.

Fig. 5 is a case of gonorrheal arthritis of one month's duration. The roentgenogram showed the bone normal. The synovial fluid shows a slight cloudiness compared with the normal ankle. Fig. 6 shows a case of longer standing; eight months since the initial lesion. There are marked changes in the articular head of the femur and the acetabular cavity allowing a partial dislocation. Fig. 7 shows a case similar to the last one reported, only of longer duration; eight years since the initial trouble with the joint. It is now in the quiescent stage firmly ankylosed. In the early cases of gonorrheal arthritis, the findings are usually negative.

The typical roentgenogram of tubercular osteitis shows rarefaction of the bone (atrophy), one or more areas of bone destruction and a peculiar hazy appearance simulating a poor slate. The latter helps to differentiate bone atrophy found in atrophic arthritis; bones of the aged atrophy from nonuse and from the absorption of lime salts in tubercular osteitis. Primarily tubercular infection of the shaft of bones rarely occurs except in the phalanges, metacarpal and metatarsal bones.

FIG. 2. ACUTE OSTEOMYELITIS OF THE FEMUR, DURATION FIVE DAYS.

Shows an area of increased radiability of the lesser trochanter. The cortical layer of the shaft of the bone shows very plainly, due to the pus beneath the detached periosteum.

It occurs most frequently in early life and is often associated with involvement of the joints. When the disease is confined to the synovial membrane and cartilage, the roentgen plate may show bone atrophy and effusion in the joint, but is often negative. There are cases of tubercular osteitis where erosions in the bone outside the joint are shown on the roentgen plate, but nothing in the joint itself. Common examples of this type are found in the olecranon of the ulna, the great trochanter of the femur, and the internal or external condyles of the femur. Removal of the diseased area will usually cure these cases. In others, however, the signs of joint disease persist, although the roentgen plate shows no joint involvement. This is due to pathologic conditions already in the synovial membrane of the joint and does not show on the roentgenogram. In acute tubercular osteitis the hazy appearance is usually well marked, together with rarefaction and atrophy of the bone. This may be all that is shown on the roentgenogram.

FIG. 4. SAME CASE AS FIG. 3; TAKEN TWO YEARS LATER, SHOWING THE GROWTH OF THE BONE.

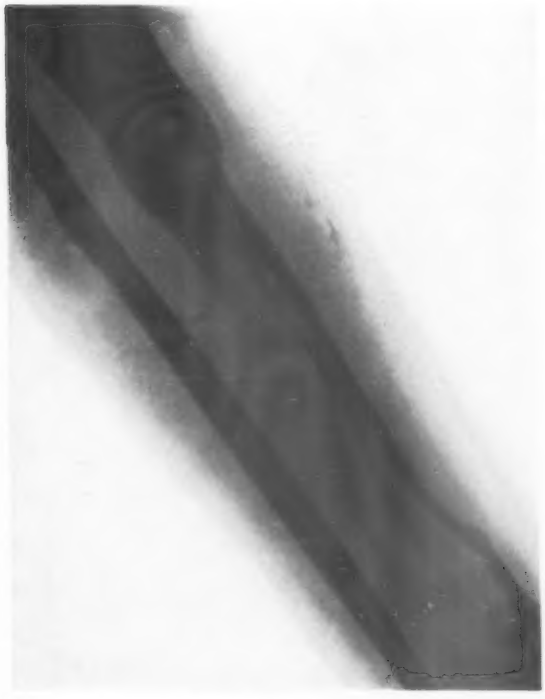

FIG. 3. CASE SIMILAR TO FIG. 1.

Where surgeon removed seven inches of the shaft of the tibia, leaving as much of the periosteum as possible. This plate was taken six months after operation.

In these cases areas of bone destruction, even with abscesses, often blend with areas of rarefaction, so that the outline of the abscess cavity is ill defined and the extent of the diseased bone cannot be told from the examination of the roentgenogram. The clinical symptoms must be kept in mind and the extent of the operation is indicated by the bone-softening, presence of sequestra or pus. In quiescent cases of tubercular osteitis, the extent of bone destruction or wall of abscess cavity is usually well defined on the roentgenogram, and a general appearance of rarefaction takes the place of the hazy appearance. In tuberculosis of bone, we find no proliferation of bone. We have rarefaction without bone growth. Primarily, it is a joint disease affecting the adjacent cancellous structure and very seldom occurring in cortical bone or the periosteum. As regards the prognosis in tubercular lesions of bone, the roentgen ray is of the utmost value in the study of the progress of cases.

FIG. 5. GONORRHEAL ARTHRITIS OF THE ANKLE JOINT, OF ONE MONTH'S DURATION.

The roentgenogram shows some cloudiness of the synovial fluid, but no bone involvement.

FIG. 6. GONORRHEAL ARTHRITIS OF THE HIP-JOINT, EIGHT MONTHS' DURATION.

Entire head of femur roughened and some involvement of upper part of the acetabular cavity allowing a partial dislocation.

Syphilis of bone is very difficult to diagnose due to the different methods of affecting the bony structure. The three chief manifestations of syphilis of bones are epiphysitis, periostitis and gumma. Syphilitic epiphysitis shows on the roentgenogram as an irregular epiphyseal line, thickened epiphyses and periosteal new bone formation on the shaft side of the epiphyseal line. It differs from tuberculosis in that in the latter we find rarefaction. Syphilis affects the epiphyseal side rather than the diaphysis. Occasionally erosions and separation of the epiphysis results from syphilis, also the periosteal thickening may occur on the shaft side of the epiphyseal line in tubercular epiphysitis. In these cases, the diagnosis cannot be made from the roentgenogram alone, but must be reached by weighing all the evidence in the case. The second type or syphilitic periostitis usually presents a typical roentgenogram. We find it affecting the convex surface of long bones, showing a thickened and irregular outline (lace-like) of the periosteal covering due to the condensing osteitis in and on the surface of the bone, and a deposit of new bone under the periosteum chiefly at the expense of the medullary cavity. This sclerosis may either be localized or extend throughout

FIG. 7. ANKYLOSED ELBOW-JOINT SHOWING THE FINAL RESULT OF A CASE SIMILAR TO FIG. 6, NINE YEARS SINCE THE INITIAL INVOLVEMENT.

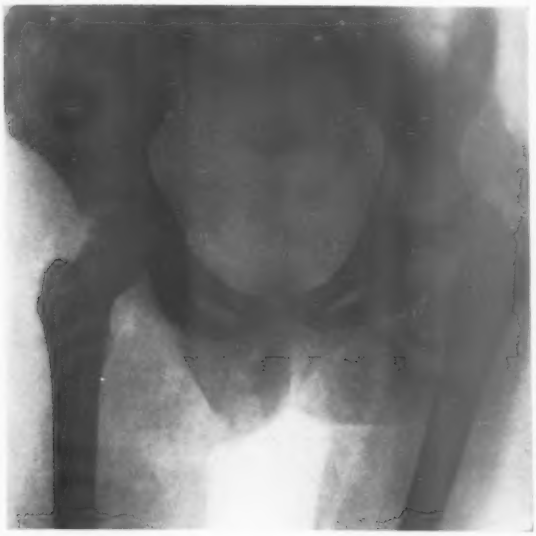

FIG. 8. TUBERCULOSIS OF THE RIGHT HIP-JOINT. HISTORY OF TWO MONTHS' DURATION.

The upper rim of acetabular cavity, the head and neck of femur showing involvement.

the length of the bone. In the third type localized gummata are formed in the bone and lead to rarefaction (syphilitic caries)

FIG. 9. "TRAVELING ACETABULUM" IN A WOMAN THIRTY-SIX YEARS OF AGE.

The result of an untreated tubercular lesion when a child. Lesser trochanter in remnants of acetabular cavity. Entire head and neck of femur gone.

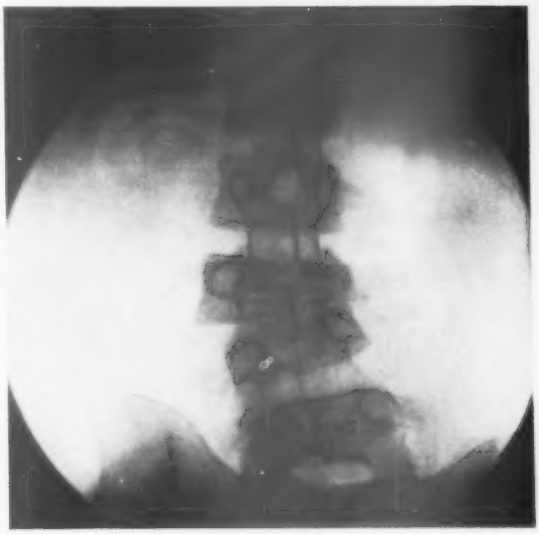

FIG. 10. TUBERCULOSIS OF THE SPINE. INVOLVEMENT OF THE BODIES OF THE THIRD AND FOURTH LUMBAR VERTEBRÆ.

with formation of new bone around. Periosteal thickening is also commonly present in the bones beneath syphilitic ulcerations. Chronic osteomyelitis, osteoperiostitis from typhoid infection, and early periosteal sarcoma must be kept in mind in differential diagnosis.

Osteosarcoma can be divided for roentgen study into two classes, the periosteal

FIG. 11. SAME CASE AS FIG. 10; SHOWING BONE GRAFT IN PLACE.

and central. The disease in the first group starts in the bone or the periosteum and may even start from the outside layers of the periosteum involving the soft parts, itself remaining intact between the bone and the growth. Most frequently a new bone is formed beneath the periosteum so that the tumor is encased in a thin bony shell. Perforating this and the periosteum, the tumor invades the soft parts. The roentgen appearance is that of blurred and irregular shadows due to the incomplete ossification that appears to radiate from the center of the growth. In central sarcoma the roentgen appearance depends upon the rate of growth. In the rapidly growing round or spindle-celled sarcoma the tumefaction visible to the eye is accompanied by a more or less complete disappearance of the bony tissue in the roentgenogram, as though the bone had been eaten away or scooped out. In advanced cases the bone may be reduced to a mere shell and is liable to spontaneous fracture. Such a roentgenogram is quite diagnostic and unlike that of any other lesion. In the slower-growing types, the giant cell variety, the roentgenogram reveals a cyst-like appearance in which may be seen irregularly placed trabeculæ of bone. The growth is enclosed in an outer shell composed of a layer representing the periosteum, beneath which is a layer of compact bone. In Fig. 15 the growth is gradual, expanding in all directions, leaving merely a thin bony shell which forms a capsule to the tumor. The expansion of the bony capsule in myeloid sarcoma is more abrupt and circumscribed than in benign cysts. Frequent roentgen examinations should be made in doubtful cases to study the behavior of the growth.

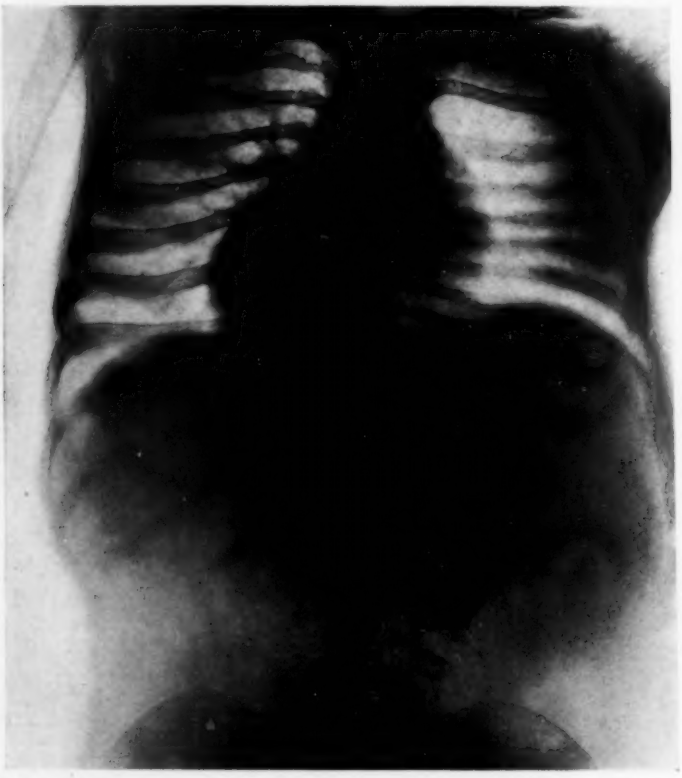

FIG. 12. MARKED CASE OF SCOLIOSIS FROM UNTREATED POTT'S DISEASE.

In myeloid tissue, we have two distinct groups of cells. First the osteoblasts and osteoclasts, second, the erythroblasts, megalocytes, myeloblasts and lymphoblasts. The first class mentioned has to do with bone formation. The second class are the mother cells of the red blood cells and leukocytes. These are two groups of cells of widely different function. It has been observed that under certain unknown conditions any or all of these cells may react by growth to some particular stimulus. The osteoblast has as its function the building up of bone, reaching its maturity as a fully developed bone cell. The osteoclast or myeloplax in which we are now interested in the cases under discussion has as its function the destruction of bone and is only secondarily concerned in the growth of bone. Adami feels that the giant cells in these tumors have the characteristics of mature myeloplaxes; therefore, the term sarcoma is not appli-

FIG. 13. SYPHILITIC PERIOSTITIS OF THE TIBIA. "SABER TIBIA."

Anterior part of shaft more convex than normal, due to the thickening of its cortex at the expense of the medullary canal.

cable; also the non-malignant character of these tumors would bear this out. His description of a giant cell myeloma is as follows: "It grows locally, most often in the marrow of the long bones and the jaw. Its growth is expansile, leading to absorption of the surrounding bone. It is abundantly vascularized. It does not form metastases save in the infrequent cases in which it undergoes sarcomatous modification. It does not recur on complete removal, and as recently shown, to prevent recurrence, it is only necessary to remove the portion immediately involved with very small surrounding zones. Histologically it exhibits a body formed mainly of short spindle-cell elements of fibroplastic type, somewhat irregular in shape, varying from typical spindle to polygonal cells and among these are numerous giant cells of the type described as myeloplaxes."

In some cases, we have the formation of bony spicules and lamellæ in the parts of the tumor where the giant cells are least abundant. This is shown on the roentgenogram of the case represented by Fig. 16. There are many different opinions by different writers leading to numerous, confusing and misleading nomenclatures. It will be necessary for the histopathologist to determine the character of these giant cells, whether they are of the foreign body type, as Barrie contends, or are the true tumor cell derived from a transitional stage of the myeloplax. These lesions involve most frequently the long bones and the lower jaw. They may appear in short bones. The age is generally the mid-period of life. Jones reports one case involving the patella; Prince, two cases of the os calcis. As far as I know the case described in this paper is the third to be reported of the os calcis and the fourth of the short bones. The case reported in this paper was a woman thirty-six years of age, employed as a saleslady. She gave no definite history of trauma. Duration of illness was three or four years. She was treated for flat foot, wore numerous devices and specially made shoes, had a tenotomy on the tendon of Achilles (an Italian operation devised for the treatment of flat foot), was

FIG. 14. SYPHILIS OF THE FEMUR.

The roentgenogram shows much coarse thickening of the irregular areas of sclerosis. The medulla is with difficulty differentiated from the cortex. Also shows a pathologic fracture.

FIG. 15. MEDULLARY SARCOMA OF THE LOWER PART OF THE RADIUS.

considered a neurasthenic, and finally a roentgenogram revealed the true condition. She was operated on, cavity thoroughly curetted, shell of bone broken down and overlying tissue brought together with catgut and skin incision closed. Foot put in a cast and healed without infection. Two years later, with a shoe built to support the heel, she had a perfect recovery as shown by Fig. 17, taken one year after operation.

Osteitis fibrosa or von Recklinghausen's disease, very much similar to the giant cell tumor described in this paper, has many characteristics in common. According to Bloodgood, we cannot differentiate giant cell tumors and bone cysts from osteitis fibrosa by means of the roentgen ray. Clinically, we find in osteitis fibrosa more tendency to fracture. Roentgenographically, we often find a more vascular condition, often showing the openings of the dilated vessels on the peripheral wall of the giant cell tumors. The essential change which occurs in osteitis fibrosa is the replacement of the bony structure by fibrous tissue in the form of longitudinal striæ containing cysts. Like giant cell tumors, it most frequently affects the long bones and is a disease usually found in the mid-period of life, or between the ages of twenty and fifty. The cause of both these lesions is believed to be the same, trauma or some mechanical factor, together with some perverted action of the internal secretions. The case reported in this paper was that of a woman forty years of age, giving a history of a slight injury one year before. Had an injury to arm from getting up from a chair, and the roentgenogram taken shortly afterwards revealed the condition found on Fig. 18. The arm was immobilized and put at rest; nevertheless, we find that the print from roentgenogram as represented by Fig. 19, taken one month later, shows no sign of repair. The diseased bone was then removed and a bone graft was inserted. Fig. 20, taken three months after operation, shows the result.

In differential diagnosis, especially from the last two cases reported, sarcoma must first be excluded. In sarcoma, we find extreme rarefaction, the expansive character, its irregular progression, often the indefinite outlines, its opacity, its early rupture through the periosteum and the involvement of the surrounding soft parts. Clinically, the early appearance of pain, interference with function and the more rapid growth will usually aid in the diagnosis.

FIG. 16. GIANT CELL TUMOR OF THE OS CALCIS.

FIG. 17. SAME CASE AS FIG. 16; TAKEN ONE YEAR AFTER OPERATION.

Carcinoma of bone is usually secondary to a growth elsewhere in the body. The bone is not enlarged to the extent that the clinical examination would suggest and the roentgenogram shows the bone irregularly eaten away. The involvement may be very extensive with few clinical signs. There is as a rule no attempt at new bone formation.

In osteitis deformans, or Paget's disease, we have a rarefying osteitis, progressive in character, which in the early stages may be difficult to differentiate, but later characteristic bowing of the legs and bending of the spine, together with enlargement of the head, helps to differentiate these lesions.

Osteomalacia is a rare disease. We find the roentgenogram shows the shaft of the bones narrow, the cancellous tissue greatly rarefied and the central canal disproportionally wide. This disease may occur at any age and runs a very chronic course. It usually commences in the spine or pelvis, but may extend to the entire skeleton, resulting in deformity from bending or twisting, and frequent fractures.

Osteogenesis imperfecta is a disease of fetal life or early infancy. The chief clinical feature is multiple fractures due to the extreme brittleness of the bones, resulting in deformity and crippling of the limbs. The roentgenogram shows the compact layer of the bones thin and transparent to the ray. The bones are broader than normal and they consist of coarse-meshed cancellous tissue which often presents a cystic appearance in places.

Exostoses or bony spurs are easily recognized on the roentgenogram. The free extremity is usually turned away from the nearest joint, and is in direct continuity with the shaft, and is composed of irregular masses of bone.

Enchondromata usually occur in early life and are found most frequently in the toes and fingers, where they are usually multiple. The roentgen appearance is that of a relatively transparent mass growing within the bone and causing expansion. It is often difficult to differentiate from bone cyst.

FIG. 18. OSTITIS FIBROSA CYSTICA OF THE HUMERUS WITH A PATHOLOGIC FRACTURE.

FIG. 19. SAME CASE AS FIG. 18; TAKEN ONE MONTH LATER, SHOWING NO ATTEMPT OF NATURE TO UNITE THE FRAGMENTS.

Scurvy in the acute stage shows on the roentgenogram a light fusiform shadow where the subperiosteal hemorrhage has occurred. Later the hemorrhage gives a darker shadow between the bone and periosteum. The shadow of the bone is darker than that of the unaffected side, because of the hemorrhage surrounding the bone. The periosteum is raised, but smooth, differing in this respect from sarcoma.

Rickets gives a very characteristic appearance on the roentgenogram, the most striking feature being the great change in the epiphyseal area of the bones. The long bones are bowed and the cortex on the concave side is markedly thickened. The epiphyseal ends of the diaphyses are broadened and frequently contain small irregular areas filled with tissue of very little density. The center of ossification of the epiphysis is small and presents a smooth contour towards the joint, and an irregular one towards the epiphyseal line. The epiphyseal cartilage itself is much thicker than normal, and its demarcation from the diaphysis is very indefinite.

CONCLUSIONS

1. The roentgen ray is of the utmost value as an aid in the diagnosis of many bone and joint lesions.

2. The roentgenogram is pathognomonic of some diseases.

3. The roentgenograms are similar in some diseases. We should, therefore, never forget the clinical findings, and carefully weigh the evidence from all points of view.

4. The roentgen ray should not be relied upon in early cases of pathologic bone, because changes in structure (density) are not produced. Particularly is this true in tuberculosis and acute osteomyelitis.

5. The pathologic process may not give us a true picture due to the fact that the roentgenogram does not show difference in the composition of substances of the same density.

6. The roentgenologist must continue with earnest zeal in this comparatively new field of diagnosis, and not feel chagrined in a mistaken diagnosis. Remember that occasionally the pathologists disagree when they have access to the specimen before them.

FIG. 20. SAME CASE AS FIG. 18; TAKEN THREE MONTHS AFTER BONE-GRAFTING.

ROENTGEN PLEURITIS

BY LLOYD BRYAN, M.D.

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THE fact that roentgen ray exposures may, at times, cause an irritation of the deep tissues such as the nerves, the kidneys, the pleura, the peritoneum and the gastro-intestinal tract, has been reported by several German authorities. These two cases of pleuritis, following roentgenotherapy, are presented as further confirmatory evidence.

CASE I. Mrs. P., age 56, complaint—coryza. Physical examination showed dulness in the upper left chest and roentgen examination, February 14, 1916, showed a smooth-edged tumor-mass extending from the left hilus forward and upward, apparently not involving the pleura. Treatments by a Coolidge tube were administered at a target skin distance of ten inches, through three millimeters of aluminum with a parallel spark gap of eight and one-half inches, as follows:

June 29, 1916—front left chest—50 milliampere minutes.

July 12, 1916—left back—40 milliampere minutes.

July 21, 1916—front left chest—50 milliampere minutes.

Plate taken at this time showed no evidence of effusion.

Aug. 7, 1916—left back—40 milliampere minutes.

Aug. 21, 1916—front left chest—40 milliampere minutes.

Plate this date shows diminution in size of tumor and small effusion left base.

No further treatments.

Plate, Dec. 6, 1916, shows no evidence of fluid, tumor somewhat increased in size.

Conclusion.—Primary lung tumor, mild radiopleuritis.

CASE II. Mr. D., age 31. In February, 1914, he entered the University of California Hospital. Complaint was weakness, hoarseness, loss of weight, masses in the neck greatly increasing over a period of 7 months. Examination showed paralysis of left vocal cord and a large mass extending from above the clavicles to the diaphragm, further to the left than to the right, masking particularly the inner heart shadow. Patient received series of roentgen ray treatments; the masses disappeared; patient gained 30 pounds in weight. In September 20, 1915, he reëntered the hospital with fluid in the left chest, having recently received intensive roentgen ray exposures outside the hospital. At this time he showed a moderate effusion at the left base. The paralysis of the vocal cord, tumor masses in the neck and the mediastinal shadow had entirely disappeared. In November, 1915, he reentered the hospital with pain in the left side of abdomen and an irregular mass in the left flank, which disappeared under intensive treatment. There was no effusion at this time. Since then he has been fairly well under mild, continuous roentgen ray exposures and no recurrence of the effusion.

Conclusion. — Lymphosarcoma. Roentgen pleuritis.

Strasser[1] cites the following case. Patient 68 years—man. For 15 years he has had gout; for 9 years a mild glycosuria, fatty heart and arteriosclerosis; for 4 years bronchial catarrh, twice a small bronchopneumonia in left lower lobe, never a pleurisy. Early in 1910 patient slowly developed stenosis of trachea and esophagus. Fluoroscopy by Holzknecht showed tumor of the mediastinum behind the manubrium extending to the right beyond the sternum, showing a transmitted pulsation, compression of the trachea, displacement of the esophagus to the left. Patient received treatments as follows:

Dose of 3½ H.

June 10.—Front of right chest.

June 17.—Right axilla.

June 28.—Right thorax posterior.

There was a severe skin reaction after the three treatments and attacks of anginal pain. Difficulty in breathing and swallowing rapidly diminished following radiation, but the patient began running a low evening temperature. On July 12th, a slight pleuritic rub was heard on the right side. Two days later a definite effusion occurred, which in a week extended to the angle of the scapula. With rest in bed the fever disappeared in one week and the pleuritic symptoms in four weeks. The patient went to the country and was all right until March, 1911, when he had a slight hemoptysis. The roentgen ray showed no sign of the tumor at that time.

Fellner and Neuman [2] give an account of the radiation of four dogs with high doses. Laparotomy later showed ascites.

Jaksch, [3] Primbram and Rotky [4] called attention to possible direct radio effect on the kidneys with consequent albuminuria and also observed diarrhea and pleuritis following heavy doses.

Quadrone [5] reports that in addition to skin lesions there has been reported a form of ascending neuritis and also that Penzoldt observed phlegmonous gastritis, also nephritis with albuminuria and casts. He reports two cases of lymphatic pseudoleukemia. The first in a girl of 12 who, after fifteen exposures, developed dyspnea and right-sided effusion, of which 1½ liters were removed, of a light, straw-colored fluid containing many corpuscles. The second case in a 28 year old man in the third year of the disease. After thirty exposures he experienced severe gastro-intestinal intoxication and skin reaction. After five further treatments, slight dullness at the base of the left lung. After seven further treatments, chest tap showed thick, yellow exudate, of which a liter was removed. The effusion in both cases had a specific gravity of eleven hundred and twenty-eight to eleven hundred and thirty, thirty-six per cent. albumin, numerous small lymphocytes and red cells, very few polymorphonuclears. In a discussion of the cases Quadrone asks whether they are due to a late complication of pseudoleukemia, to broken down tuberculous glands at the hilus, or obstruction of the vena cava or direct effect on the pleura. He concludes that the latter is the case because the effusion was an exudate without the characteristics of tuberculous processes, without leucocytes; because the pleuritis appeared when the lymphoma was reducing; because it appeared on the site where the radiation was strongest and because it recurred with subsequent treatment.

That lung tumors may extend to the pleura, causing an effusion, and that in lymphosarcoma a pleurisy with effusion is not infrequent, are well known facts and it might be argued that in the two cases here cited, pleuritis may have occurred without the roentgen exposures. However, it should be noted that in our cases, as in those from the German authorities, the effusion disappeared on cessation of the treatments, while the primary condition was greatly improved. In cases of effusion occurring without radiation, the condition is more apt to be progressive.

It would seem, with the high penetration and filtration now in general use, together with cross-firing, that irritation of the deeper structures, particularly the pleura, must occur more frequently than the English literature would seem to indicate.

We wish to record these two cases, not as absolutely proven ones, but to emphasize the possibility of a pleuritis and perhaps stimulate investigation along this line.

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THE ROENTGEN DIAGNOSIS OF TRAUMATIC LESIONS OF THE LOWER BACK

BY ERNEST L. DAVIS, M.D.

SPRINGFIELD, MASS.

BACK injuries have a bad reputation. In no small measure this is richly deserved, because of the serious difficulty in making a correct diagnosis on the one hand, and on the other because of the ready opportunity for malingering afforded the unscrupulous patient. As a natural consequence surgeons view all trauma of the spine with more or less anxiety and distrust. Even a perfectly honest patient frequently excites suspicion because his symptoms seem all out of proportion to the trivial nature of his injury. That disability, therefore, often seems unduly prolonged is a not unnatural plea; and that it is more often made ever since workmen's compensation acts began to extend pecuniary aid to injured employees, is not at all surprising. It may perhaps be that this financial aspect is the immediate cause of the commendable interest now directed toward back injuries. Be that as it may, one immediate effect of compensation acts is an earnest attempt not only to shorten the period of disability, but what is more to the point, to clear up the whole matter of spinal trauma. With this end in view the aid of the roentgen ray is being invoked, and that no little is being accomplished is due in great measure to the painstaking work of roentgenologists. Thanks to their findings it is universally granted that every case of back injury, however trivial, demands a roentgenogram; for the roentgen ray men are proving time and again that beyond all doubt fracture of a vertebra may exist when clinically it is least expected. Particularly is this true of the lower back.

While the roentgen ray is taking a huge burden from the surgeon's shoulders and relieving him of much responsibility in spine injuries, the roentgenologist finds himself confronted with some very perplexing problems. In the first place the roentgen examination is so often negative that the roentgenologist has to take great pains both in technic and interpretation, lest he overlook an apparently slight lesion which may really be very important. In the next place, while it is usually very easy to show the first four lumbar vertebræ on a plate and to interpret what is shown, it is exceedingly difficult even to show the fifth lumbar, to say nothing of interpreting the image when shown. Furthermore it is under ordinary circumstances not difficult to show the bony pelvis and to show it well, but in the iliosacral region, at least, interpretation may be difficult. Even more perplexing are the adventitious shadows that complicate all plates of the lumbar region. Fecal masses and gas sometimes cast confusing shadows, and finally the lines of the articular processes which are seen many times projected through the vertebral bodies are apt to be mistaken for fractures, especially as it often happens that these lines are seen more distinctly in one vertebral body than in all the others. Many of these back cases get into court, or at least before an arbitration board, and necessitate expert testimony from roentgenologists. Confronted as they are with trying perplexities of interpretation, it is well to be charitable and to regard the conflicting testimony as honestly given, however biased and ridiculous it may appear.

It is well known that not infrequently in making a roentgen examination of the lower back, fractures of vertebræ are discovered in cases where clinically there is little or perhaps no evidence of fracture. Even in cases where fracture is scarcely more than a remote possibility, where no deformity is detectable by ordinary clinical means, and where no sign or symptom pointed to fracture, one is found by the

roentgen ray, not in a few but in many instances. It is usually of the compression fracture type, and most often in the upper lumbar region. It is produced by a form of violence causing longitudinal jarring of the spinal column or forcible bending beyond physiological limits, and the degree of violence is often surprisingly slight.

The lumbosacral region presents the greatest difficulties of interpretation. The body of the fifth lumbar vertebra differs in shape from its fellows in that it is wedge-shaped with the narrow end of the wedge directed backward. Its axis points back and up. Moreover the whole bone so lies that the rays fall obliquely upon it and through it, thus projecting upon the plate an image that is more or less ill-defined. On plates taken with the tube parallel with the plate the fifth lumbar vertebra always has the appearance of being crushed, for the upper part of the sacrum obscures the posterior part of its body. It has been suggested that a lateral view be taken of the fifth lumbar in order to show its relation with the sacrum. Personally, I have as yet been unable to get satisfactory plates of the lower part of the fifth lumbar by so doing. On the contrary, with the patient on his back, with the cone just above the pubic arch, and with the tube tilted towards the feet (reversed bladder position), I have been able to show the body of the fifth lumbar more plainly. Yet I have to confess that this maneuver has the disadvantage of throwing the shadow of the fifth somewhat on that of the fourth.

Many times on plates taken of the lumbar spine there appear to be depicted apparent curvatures. If any curvature is seen, it is well to note the shapes of the involved bodies and the intervertebral discs. In temporary curves the discs present definite wedge shapes; the bodies are unaltered. Moreover the spinous processes retain in temporary curvature their medial positions relative to the bodies. In general a localized deviation is pathological, whereas a generalized deviation of the spinous processes to one side is usually due to the position of the tube which was not centered vertically in the median line.

Sacro-iliac strain and sacro-iliac dislocation are perhaps the commonest injuries diagnosed in the class of cases where liability is concerned. In fact, such injuries now constitute the favorite claim of the plaintiff. Unfortunately for him, my experience is that roentgenograms of these alleged injuries make better evidence for the defendant. I say this because after examining a great many plates showing the sacro-iliac joints I have only once seen what I could honestly say was a change in the normal relations of the bones. I exclude, of course, cases showing obvious disease of the bone. Either the roentgen ray does not demonstrate sacro-iliac dislocation, or it is a very rare injury. Sacro-iliac dislocation, even to a degree that allows the irregularities which form the surface of the articulation to catch on opposing irregularities, is rarely shown on roentgenograms. And yet it is heard not infrequently that a roentgen ray plate shows even a relaxed sacro-iliac joint. Unless accustomed to read plates of this region, it is easy to go astray. Careful study of the roentgenogram generally brings out the disquieting fact that the tube was not centered over the sacrum, which accounts for the apparent difference in the joints of the two sides.

Many times in making plates of injured backs evidence is obtained of hypertrophic bone conditions which undoubtedly existed long before the present injury is claimed. Likewise there are occasionally found developmental malformations, some of which simulate fracture of the lamina; sometimes a spinous process or adjacent portion of the neural arch is found absent. In all malformations, however, the free ends of bone are not irregular, but rounded off. Occasionally, however, there is an apparent overlapping of the free ends, which cannot always, therefore, be clearly outlined. As for dislocations, I would say that I have never seen a roentgenogram of a dislocation of a lumbar vertebra without fracture.

It is obvious, therefore, that all back

injuries should be roentgen rayed. While it is true that with present knowledge and technic the roentgen ray does not show bony lesions in a large number of cases claiming disability in the sacro-iliac region, it is certainly most satisfying to physician and patient alike to be assured that no fracture nor dislocation is present. With further advances it may well be shown that sacro-iliac strain is really a forward dislocation of the fifth lumbar vertebra on the sacrum.

SOME ROENTGENOLOGICAL OBSERVATIONS ON THE DIAGNOSIS OF TUMORS OF THE JAW

BY J. W. PIERSON, M.D.

BALTIMORE, MD.

IT is not the purpose of the writer to present anything new on this subject; but his object is to correlate the few salient points which he has been able to gather, in this difficult but interesting subject. The diagnosis of tumor of the jaw is fraught with many difficulties for the surgeon, and the course of treatment is so radically different in the different varieties of growths, that any light which may be shed upon the subject from a roentgenological standpoint should be extremely beneficial for all concerned. We shall consider the benign tumors first.

Epulis

This is by far the most common tumor of the jaw. It is a topographical term applied to a new growth, seated at the edge of the alveolar border. Histologically considered it arises from the periosteum or connective tissue beneath the mucous membrane, and is a border-line growth between an inflammation and a neoplasm. While it is essentially a fibroma, it sometimes undergoes a giant cell formation. There occasionally occurs a variety which contain small spicules of bones which are thrown off from the growth from time to time, and which can be demonstrated roentgenologically.

Being essentially a growth of the young it occurs most frequently between the ages of twenty and forty, and is more frequently seen in women than men. Its favorite location is in the upper jaw in the region of the canine, bicuspids, or first molars, almost never occurring back of the first molar.

These various pathological and clinical points are mentioned because they have a direct bearing on the roentgenological appearance of the growth, and should be borne in mind when attempting a diagnosis.

Roentgenologically an epulis appears as a small cystic formation, which is confined to the alveolar border of the jaw and does

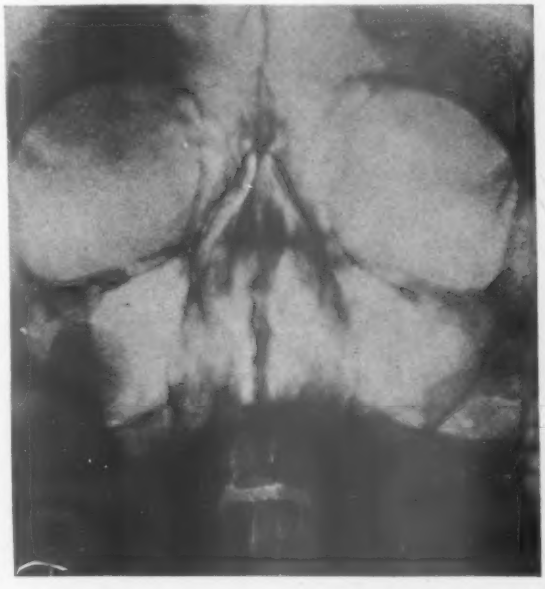

Fig. 1. Polyp in Right Antrum.

FIG. 2. DENTIGEROUS CYST OF RIGHT ANTRUM.

The tooth has been carried up into the antrum by the growth.

not invade the body. The walls of the growth are clear cut, and there is no evidence of any inflammatory reaction, characterized by new bone formation surrounding the growth. Occasionally it takes on a giant cell formation when it is very difficult to differentiate from the giant cell sarcoma; and occasionally, as above mentioned, small spicules of bone may be seen in the growth projecting out beyond the alveolar border.

ODONTOMA

The next most frequently occurring tumor of the jaw is the odontoma. This is a term applied to a tumor of the jaw arising from a portion of a root follicle. Under it are grouped the Adamantine Epitheliomata, Dentigerous cysts, Dental Root cysts, and the Hard Odontoma. There have been many more elaborate classifications, but for our purposes the one which we have adopted will suffice.

Adamantine epitheliomata arise from epithelial rest or paradental epithelial debris, which start an adventitious development during the formation of the tooth. It is the least malignant form of epithelial tumor found in the lower jaw. We usually find this tumor in the lower jaw at the angle in the region of the last molar, although we occasionally find it in the upper jaw. It is twice as common in the female as in the male, and occurs more frequently between the ages of twenty and forty. Its roentgenological appearance does not differ materially from dentigerous cyst with which it is frequently confused.

Dentigerous cyst is the most common form of odontoma, always occurring in young people. It never starts after the permanent set of teeth are erupted. It may be found in the body of the jaw at the angle, and may be found also in the ramus of the jaw and in the antrum.

Its roentgenological appearance is that of a cyst occurring in the regions described, having a dense, bony capsule, so that there is a marked swelling of the jaw before the capsule ruptures. The cyst may contain either a whole tooth or a portion of one, and it is quite common to see one or more teeth absent from the jaw. It is characterized by bone absorption, there being no new bone formation.

The dental root cysts are much smaller than the dentigerous cysts. They are found at the root of a tooth and are quite difficult to differentiate from large alveolar abscesses.

The hard odontomata present the appearance of a cyst filled with solid bone. They are relatively infrequent.

GIANT CELL SARCOMA

We have classed the giant cell sarcomata as benign, because, like the tumors already described, they will not recur nor cause metastases if properly removed. This is the most common variety of sarcomata found in the jaw. In fact, of the whole anatomy, the jaw is its favorite location. It rarely appears after the thirty-fifth year, and is found much more frequently in the lower jaw than the upper. It is the only variety of sarcoma of the jaw that we find in very young children.

Roentgenologically we see a growth which involves the body of the jaw in the region of the angle. Sometimes we may find it at the symphysis. It has a perfectly characteristic appearance, there being absorption of bone and a very extensive network of trabeculæ running through the whole of the growth. It is in no wise invasive in character, although it may occasionally rupture through the cortex of the bone. While its general characteristics are benign it may, if allowed to grow a sufficient length of time, involve a very large portion of the jaw, so that its local effects are really as bad as a malignant growth. Occasionally we see a giant cell sarcoma undergo a malignant change.

Osteomata occasionally, though rarely, occur in the jaw. When they do appear they present the usual appearance of a hard, dense, bony growth, such as are seen elsewhere in the body.

Fibromata are more common than osteomata, though they are relatively infrequent. The bone changes produced by fibromata are due principally to pressure, causing absorption of the bone. The writer has seen one case which occurred in the lower jaw, and which had the roentgenological appearance of a huge cyst, involving the whole of the body of one side of the jaw. This appearance was brought about entirely by pressure of the growth on the bone.

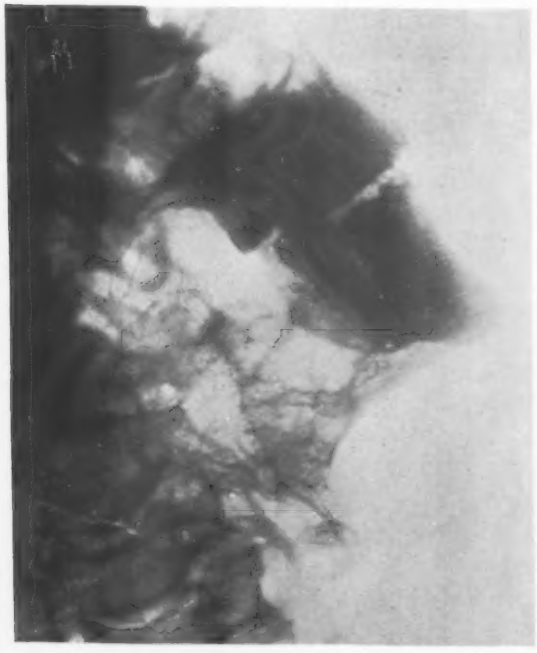

FIG. 3. GIANT CELL SARCOMA.

Outline of jaw remains intact with the characteristic trabeculated appearance of growth.

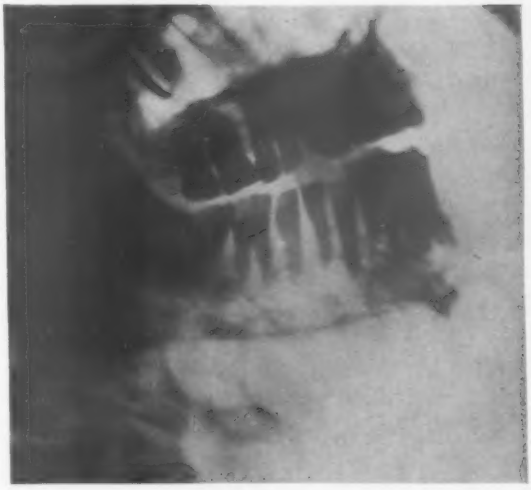

FIG. 4. OSTEOMYELITIS OF JAW.

Although there has been great destruction of the mandible, the teeth occupy their normal position.

If one will keep in mind the characteristic appearance of each of the benign growths of the jaw, as well as their histological structure and usual location in the jaw, the differential diagnosis should be fairly easy. There is one condition, however, that should always be borne in mind, that is osteomyelitis. At times this condition may very closely simulate the appearance of a growth; but it is usually accompanied by the ordinary symptoms of bone infection, viz.: thickening of the bone around affected area, occurrence of periostitis, formation of sequestra, etc.

MALIGNANT GROWTHS

Our principal concern in considering tumors of the jaw is to determine whether the growth is benign or malignant. This is not always an easy matter, and when one

notes that the surgeon will frequently wait until he cuts down on the growth before he will give his diagnosis, one will appreciate the difficulties of the situation.

We have the usual types of sarcomata occurring in the jaw, just as they do elsewhere in the body. They may originate in the medulla or from the periosteum. The periosteal type usually occurs at the angle and may completely encase the body and ramus in a new growth. Sarcomata occur more frequently in the lower than the upper jaw, and, of course, are more frequently seen in young people than in old, except in sarcomata of the antrum, which are not uncommon in old people.

Carcinomata are more frequent than sarcomata both in the upper and lower jaw. They begin at the alveolar border in the lower jaw or in the antrum in the upper, and usually occur in old people. They naturally do not begin primarily in the bone itself, but are secondary to some growth nearby. Very rarely one may see carcinoma in the jaw when there is a general carcinomatosis of the whole body.

Once in a great while we find metastatic hypernephromata in the jaw.

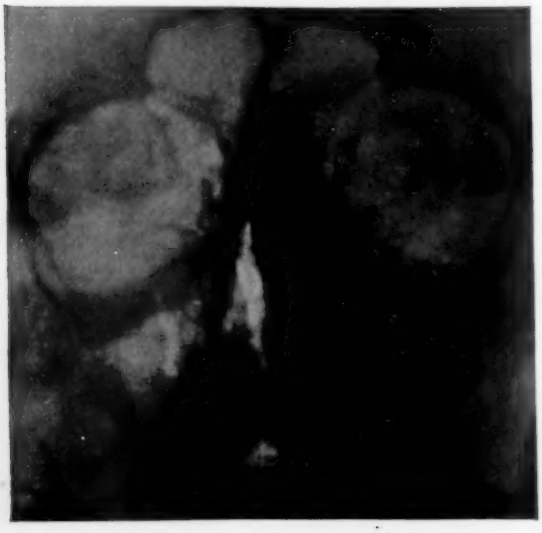

FIG. 5. SARCOMA OF LEFT ANTRUM.

Outlines of the antrum are irregular, and it is completely clouded. The growth has not broken through the wall of the antrum.

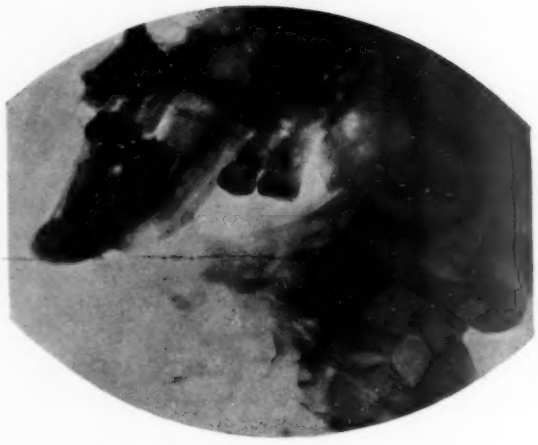

FIG. 6. CARCINOMA OF LOWER JAW.

Note almost complete destruction of mandible.

The roentgenological appearance of malignant growth is quite characteristic. If it occurs in the lower jaw the bone appears to be definitely eroded and destroyed; the edges of the growth are irregular and it presents an invasive appearance. There is usually very little bone reaction surrounding the tumor, for the growth is too rapid to allow of any. The earliest appearance of malignant growth in the lower jaw is a slight break in the continuity of the alveolar border. In the upper jaw the growth starting in the antrum soon breaks down the walls, and, depending on the direction which it takes, it may invade the orbit, nasal passages or mouth, causing a destruction of the bony walls of these cavities. The earliest signs of malignant growth of the antrum that we can detect, are a clouding of the antrum and a slight break in the outline of the walls of the antrum.

Malignant growths of the antrum are to be differentiated from empyema of antrum, polyp, odontoma, giant cell sarcoma, osteoma.

Empyema presents a homogeneous shadow, the walls remain intact.

Polypi appear as clear cut rounded masses wholly within the antrum.

Osteoma presents the characteristic appearance of a solid growth composed entirely of bone.

Odontoma shows well defined walls which may enclose one or more teeth.

Giant Cell Sarcoma presents its usual trabeculated appearance.

In considering the diagnosis of malignant tumors of the jaw, the writer wishes to lay particular emphasis on two points which have been mentioned, namely, the slight breaks in the continuity of the wall of the antrum and the slight irregularities along the alveolar border of the lower jaw, occurring early in these cases.

These points are not presented as representing any new diagnostic feature; but because they are easily overlooked unless the case is carefully studied.

REPORT OF A CASE OF MYXOMA OF FEMUR

BY ALBERTUS COTTON, M.D.

and

STANDISH MC CLEARY, M.D.

BALTIMORE, MD.

THIS case is considered worthy of report on account of infrequent occurrence, difficulties of diagnosis, and the damage done by a non-malignant tumor.

M.C.D.—female, aged 35 years, married, was referred to me for diagnosis and treatment by Dr. J. C. Madara. The following history was obtained:

Family History.—Brother died of pulmonary tuberculosis. Otherwise history was negative.

Previous History.—Negative.

Active trouble in right thigh began a little more than one year before (spring, 1915), but patient had experienced pain in right limb, especially the knee, for four or five years, and had been treated for rheumatism. At this time (spring, 1915), patient had severe pain in thigh with lameness and well-marked swelling about the middle one-third. She does not think that she had fever at this time.

At that time she was taken to the County Hospital, where a diagnosis of tuberculosis of bone was made. Tonic and hygiene treatment with rest of limb was advised by attending surgeon, and patient returned home.

Pain, lameness, and swelling gradually became worse and she returned to the County Hospital in November, 1915. At this time an operation was performed. The patient's report was that no pus was found and that examination of specimen of bone removed showed tuberculosis; she remained at the hospital four weeks and returned home.

During the winter of 1915 and 1916 patient walked with crutches and attended to her household duties, although suffering constant pain. The operative wound healed in about four months.

In spite of the fact that the wound healed, the patient experienced no relief from pain or lameness, and swelling of thigh increased in size. In June, 1916, she consulted me.

PHYSICAL EXAMINATION

Patient was about five feet six inches tall; of slight build and thin. Face had a white and pinched appearance, but mucous membranes were of good color. She had been taking opiates in moderate quantity for several months. Examination of chest showed heart and lungs normal. Stereoscope roentgen ray examination of chest confirmed findings of physical examination, showing no evidence of tuberculosis or malignancy in lungs. Examinations of abdomen, urine, and blood were negative.

Wassermann was negative. In about the middle third of right thigh there was a large swelling, irregularly fusiform, involving the whole circumference but more prominent anteriorly and externally. On palpation, swelling was hard and firm except at site of scar of previous operation on the anterolateral surface, where there was an area the size of an egg that was soft and fluctuating. Circumference of right thigh at site of tumor was three and one-half inches greater than that of left in same location.

ROENTGENOLOGICAL EXAMINATION

Plates were taken to show the antero-posterior view of the whole femur including the hip-joint and lateral view of lower two-thirds of the bone. These plates, lantern slides of which will be shown, presented the following characteristics, viz.:

(*a*) The whole shaft of femur from neck to condyles was involved in the pathological process.

(*b*) There was enlargement of the bone with rarefaction and thinning of outer compact bone.

(*c*) The rarefaction was not uniform, some areas more marked than others.

(*d*) Contour of bone was irregular on all surfaces.

(*e*) At the middle of bone an area about three inches long and involving one-third circumference was shown where bone had been removed by operation.

(*f*) Along the shaft of bone, especially at site of previous operation, were numerous small projections of new bone extending outward from periosteum in different directions.

(*g*) The shadow of the tumor could be seen extending in the soft tissues on all sides of femur.

While the clinical and roentgen ray evidence seemed to point to diffuse osteosarcoma, a diagnosis was reserved until an exploratory operation could be done.

On June 20th, 1916, an incision was made over the soft part of the tumor in the old scar. A cystic area was found containing a serosanguinolent fluid with wall of soft friable material like granulation tissue. The cyst extended into the bone at site of previous operation. The bone itself was rough and irregular under the periosteum with small processes of new bone extending in different directions into surrounding muscles which were firm and hard. No tumor tissue other than the soft friable tissue and spicule of new bone was noted in the exploration. Grossly, the condition did not look like sarcoma. Portions of the bone, cyst wall and muscles were removed for microscopical examination. The wound was partially closed and drainage provided.

The report of the pathologist, Dr. Standish McCleary, at this time was as follows: Tissue removed showed process of repair, granulation and fibrous tissue with new bone formation. There is no evidence of malignancy.

This report would seem to indicate an inflammatory lesion. Diseases considered as possible cause of condition, were:

(*a*) Myositis ossificans.

(*b*) Osteomyelitis, pyogenic, tubercular or luetic.

(*c*) Osteitis fibrosa or bone cyst.

Myositis ossificans was dismissed at once from roentgen ray examination. Pyogenic osteomyelitis was excluded because there was no pus (pyogenic) and tubercular osteomyelitis because of its very great infrequency in adults. Lues was excluded by negative Wassermann, history, clinical and roentgen ray examination. Neither the clinical signs nor roentgen ray plates were typical of osteitis fibrosa or bone cyst, unless the character of pathological process had been changed by the exploratory operation.

The patient experienced some temporary relief from pain and was allowed to go home in about three weeks to be looked after by her family physician.

Five months later, November 20th, 1916, patient returned to Mercy Hospital. Physical examination at this time showed

general condition not so good; patient thinner, anemic and weak. She had suffered increasing pain and had been taking morphia in moderate dose daily for past three to four months. Examination of right thigh showed enormous enlargement, more than twice the size of left limb; numerous large surface veins; greater portion of tumor firm, but two or three areas of softening; small sinus from previous operation.

ROENTGEN RAY EXAMINATION

The plates showed same appearances as my previous examination with the following exceptions: the bone was larger and showed more general rarefaction; there was a pathological fracture at site of previous operations; there was no increase in periosteal new bone formation. In spite of the long duration of the disease, over one and one-half years, a diagnosis of osteosarcoma was made and amputation at hip-joint advised.

On November 28th, 1916, disarticulation of the hip-joint was done. Patient suffered very little shock from the operation, had a satisfactory convalescence and after several weeks completely recovered. It is now nearly one year since the operation and patient's general and local condition is good with no indication of recurrence of tumor.

Examination of amputated limb was made at the time of operation and was as follows: The femur was split longitudinally from top of greater trochanter to knee joint. The medullary cavity was enlarged and compact bone thin. At the site of exploratory operations there were areas of softening of bone which connected with cystic areas in the muscles similar to the one found at exploratory operation. There was new bone formation, especially about the old operative wound and fracture showing a feeble attempt at repair. Extending from the operative opening all along the shaft of bone from the trochanter to condyles between bone and periosteum, was the tumor. In some places the periosteum was broken through and the tumor extended into the muscles. The tumor was soft (not jelly-like, but firm enough to be handled without crushing), and grayish white in color. No hemorrhagic areas were found in the tumor. Neither hip nor knee joint was involved.

Report of the microscopical examination of tumor removed by Dr. Standish McCleary is as follows: Sections were made of the gelatinous material contained in the loculi found in the bone. This material is composed of pure myxomatous tissue, showing the characteristic stellate cells, slight fibrillar framework, and the gelatinous ground substance. At places in the section, rather robust bands of fibrous tissue are seen traversing the ground substance.

Sections from the osseous tissue show two distinct processes taking place. Areas showing distinct resorption of bone are met with, and with these are areas in which new bone formation is actively progressing. There are present osteoblastic cells forming cartilage and the beginning of new lamellæ.

The pathologist's diagnosis of this case is not osteosarcoma but myxoma, a non-malignant tumor. Had it been possible to obtain the pathological report before operation, the treatment would have been the same. The limb was so badly damaged that it could not subserve its function and the pain and dragging weight of the enlarged limb were weakening the patient and making her so miserable that life was not worth living.

In myxoma of bone we have a tumor which is capable of producing so great damage that amputation may be necessary, yet it is non-malignant, which means that it does not recur after removal.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

PUBLISHED BY PAUL B. HOEBER, NEW YORK CITY

Issued Monthly. Subscription, $5.00 per year. Advertising rates submitted on application. Editorial office, 124 Manchester St., Battle Creek, Mich. Office of publication, 67-69 East 59th Street, New York

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DEATH OF CAPT. W. E. HARWOOD

The first American roentgenologist to lose his life since America's declaration of war in April, 1917, was Dr. William Elvis Harwood, Captain, Medical Reserve Corps, U. S. Army. Captain Harwood, whose home was Joliet, Ill., died from pneumonia on January 7, 1918, while on duty with Base Hospital No. 12, serving in France.

The deceased was born in Joliet, November 16, 1858. He graduated from Rush Medical College in 1880 and for several years practiced in Eveleth, Minn., where he was surgeon in charge of the Fabiola Hospital and attending surgeon of several mining companies. He later returned to practice in Joliet, the city of his birth. When Base Hospital Number 12 was organized, he volunteered for service as roentgenologist, but was rejected on account of his age. He was later accepted for the roentgen ray work, because of his insistence that he was entitled to a chance to serve. Shortly after his arrival in France, in recognition of meritorious service, he was promoted to be captain.

The writer has known Dr. Harwood for several years, and can testify to his unfailing devotion to high ideals of practice. He has also had the opportunity of visiting Base Hospital No. 12 in France and of personally inspecting the work of Captain Harwood. Only one who has seen and experienced the peculiar difficulties which had to be met in the accomplishment of satisfactory roentgenologic work where Captain Harwood was stationed, can appreciate the credit due our friend for his work. His example in making the best of a difficult situation, and of succeeding in spite of mechanical difficulties, may well be held up for the consideration of those who feel that, in France, in war time, under conditions of extreme necessity of restricting one's demands to absolute needs, they should be furnished with the same luxurious conveniences they have enjoyed in civil practice at home. J. T. C.

WAR ROENTGENOLOGY

With the beginning of hostilities, in accordance with the French system of mobilization, most of the roentgen ray men found themselves thrown at once into military service, many of them in other lines of medical work, and some of them

in the fighting branches of the service; but as soon as the authorities found themselves and got the management of the war systematized, the roentgen ray men were gradually called into the service for which they were peculiarly fitted. In some instances, the transfers were made gradually. For instance, Haret, who to-day with Hirtz has charge of the roentgen ray work of the French armies, served a year in the field with a roentgen ray automobile unit. Other similar instances might be cited.

Later a school was established at the Val-du-Grace Hospital, Paris, where our honored friend, Prof. A. Béclère has charge of the didactic work. With his corps of assistants he puts the men who are assigned to this school through a course of theoretical and experimental instruction and they are later assigned to some of the fixed hospitals for practical instruction before being sent out into the field.

A school for technicians has also been maintained, the French authorities having long ago recognized the necessity for supplying roentgen ray medical workers with technicians so that the medically trained men would have more time for purely professional work. These technicians are for the most part men although there are a few women technicians. The men are trained at the general shops (*ateliers*) of the Service du Sante of the Franch Ministry of War. The term "*manipulateurs*" is applied to these male technicians. The women, "*manipulatrices*," are trained in a school established by Madame Curie.

The manipulators are trained in the care of roentgen ray apparatus, and in the art of plate making and developing. No attention is paid to diagnostic work in the course for these workers. In fact, the course for the women does not include the care of apparatus, and for this reason, the women are not popular as roentgen ray assistants.

The apparatus employed in the French army is generally recognized as being more or less below the desired standard owing to the necessities of the situation. Due to a peculiar difficulty in the manufacture of interrupterless transformers, there have been practically none of this type of instrument in the French mobile hospital. The writer has been told that the Italian roentgen ray automobiles are equipped with interrupterless transformers. Not long ago, Colonel Hirtz told me that he wished it were possible to replace the present type of old apparatus with interrupterless transformers. Owing, however, to the difficulties above referred to, interrupterless machines will not be furnished to any except the most important general hospitals. The men are obliged to content themselves with coils and mercury interrupters, instruments of the type which most of us discarded a decade ago.

The tables, tube stands, and other accessories have reached a high degree of development for the peculiar needs of military roentgenology, although the apparatus as a whole, both from the standpoint of workmanship and material, is not what we, in this country, have been accustomed to. Every move in France seems to be actuated by the overwhelming necessity of making all efforts productive of the greatest possible results with the least possible expenditure of material. The French have very frankly told us that they expect us to begin where they have left off, and it will be a great disappointment if we have to go through a period of development either in the production of roentgen ray apparatus or in the recognition of the important position which the roentgen ray must play in the war surgery of to-day. We earnestly hope that all of this experience will not have been lost and that the outcome of our present campaign of preparation for the herculean task before us will show that we have lived up to the expectations of our heroic French *confrères*.

The sense of all the above remarks applies also to our British brethren who have favored us with every possible opportunity for observation of methods. We are indebted to both French and British radiologists for many valuable suggestions.

J. T. C.

TRANSLATIONS & ABSTRACTS

HESS, J. H. Osteogenesis Imperfecta. (*Arch. Int. Med.*, Feb. 15, 1917, Vol. XIX, p. 163.)

The roentgen literature has from time to time contained very valuable contributions to this subject, but this paper undertakes to give a summary of the roentgen ray findings in this disease and the author is surely to be congratulated upon the degree of success attained. The following are summarized as the roentgen ray findings which are characteristic and diagnostic for the disease:

1. Multiple, mostly intraperiosteal fractures, often showing areas of bone resorption at the seat of fracture.

2. Excessive callus formation.

3. Deficient shadow formation seen in all bones of the body, due to increased permeability to roentgen rays. Often the bone shadows show but little more density than the surrounding soft parts.

4. The diaphyses of long bones may be slender, and only very rarely show any curvature or bending.

5. The cortex is of irregular thickness, on the whole very thin and parchment-like in appearance and may even appear to be absent in some places. There is little or no tendency toward thickening on the concave side of the shaft.

6. The spongiosa contains wide meshes and an absence of structural markings. These changes are not limited to the diaphyses. All bones show this change, but not to the same degree, the most marked changes being found in the bones of the hands.

7. The medullary cavity is increased in size and shows irregularly mottled shadow.

8. The epiphyseal cartilages and their centers of ossification are larger than normal and the epiphyseal lines are straight.

The following is quoted at length because of its value in roentgenologic diagnosis.

"The roentgen ray is invaluable in the differential diagnosis of osteogenesis imperfecta, and also chondrodystrophia fœtalis, cretinism, mongolism, rachitis, infantile scurvy, syphilis (early congenital and later manifestations) and tuberculosis of bones.

"In chondrodystrophia fœtalis the trunk is normal, while the extremities are shortened and deformed. In the skull the clivus is often seen in the lateral position and there is usually malposition of the nasal bones. If the root of the nose is retracted, they are almost horizontal, while if flattened, they are more vertical. The flattening of the bridge of the nose is due either to a primary tribasilar synostosis or a failure of development, which causes the base of the skull to be shorter. The ribs are thickened at the epiphyseal lines. The extremities are short and thick and the epiphyseal regions prominent. The center of the body is displaced upward. The shafts of the bones often show great thickenings and shortening of the cortical substance, and overgrowth of the bony epiphysis is so marked that it often appears to overlap that of the epiphyseal line. The periosteum shows great thickening, the cortical substance is broader and thickened and the medullary canal is narrow, and sometimes the latter is replaced by hard cortical tissue. Thus it will be seen that the bone changes are marked in both the length and breadth. The shortening of the long bones is due to the cartilaginous ossification of the epiphyses, and it is very evident that these abnormalities are brought about by the disturbance in the normal process of ossification in the primary cartilage" (Rotch).

"In cretinism the body length is normal at birth, but shows later a greatly retarded development. The degree of retardation varies with the degree of thyroid atrophy (directly), and the amount and length of time of treatment. There is a universally retarded development of the bony skeleton due to delayed endochondral and periosteal growth, which is especially marked in the carpal and tarsal bones and in the phalanges. There is delayed development of the bony nuclei in the epiphyses and delayed union between the epiphyses and diaphyses. The delays in bone deposits are usually very marked. A 2-year-old child may show the bone development of a 6- or 12-month infant.

"In mongolism roentgen ray examination has no great practical value, as in marked cases clinical diagnosis is easy and the bone changes have no definite pathognomonic characteristics. The general skeletal development shows no pathognomonic changes, the degree of retardation varying in different cases and different

regions in the same case, while others may show no retardation. On the whole, the bones are well developed for their age, in fact occasionally the short bones are developed too early. The skull is usually microbrachycephalic, the orbits low and converge inward, the sella turcica small, with overlapping clinoid processes, which often appear to involve the hypophysis. The hands are short and broad, due to small metacarpal and phalangeal bones. The thumb and little finger show the shortening to the greatest degree. The little fingers often show concavity on the side approximating the ring finger. This is chiefly due to shortening and curving of the middle phalanx. The thumb often shows a button-like appearance with circular-like contraction at the proximal end of the metacarpal and distal end of the basal phalanx. There is a tendency to congenital anomalies, among which bone deformities are common; clubbed feet, syndactylism, superfluous toes, spina bifida, and micromelia of the upper extremities are often associated with other congenital deformities, as of the heart, genitourinary tract and ears.

"In rickets partial or complete fractures are usual, but they are not intraperiosteal and there seems to be very little tendency toward callus formation, although apparently enough to make the bone more or less solid. The calcium content of the callus is so very low that it is almost invisible in a roentgenogram. Deformities in rickets are much more marked in the lower than in the upper extremities. Bowing and bending is characteristic. In the femur the greatest change may be in the neck, causing coxa vara. The pelvis may become flattened and the body shortened as a whole. Not infrequently palpable nodular thickenings involving part of the cortex are seen on the convex surface of the long bones. Increased radiability of bones is a property which rickets in its active stage shares with osteogenesis imperfecta. After the process in rickets subsides, the bones, while still showing deformities and curvatures, appear broader than normal and show even increased density of bone, which is especially marked at the ends of the diaphyses. The periosteum in rickets is definitely thickened, but the periosteal bone shadow is often pale, due to the low calcium content. The cortex has about the same appearance as in osteogenesis imperfecta. On the concave sides of long bones the cortex is thickened, which is almost pathognomonic of rickets; it may be thinned on the convex side. The medullary cavity is often increased in size in rickets and constantly so in osteogenesis imperfecta. The epiphyses, which in osteogenesis imperfecta are normal, show most marked changes in rickets. The zone of proliferation is widened, with an irregular, toothed appearance on the epiphyseal side of the diaphysis, and there is also a broadening and flaring out of the epiphyseal end of the diaphysis, which is very characteristic for rickets. The epiphyses tend to be larger than normal, irregular in outline and may be of decreased density. The end of the shaft is streaked and presents an irregular line at the joint end and above it a curious transverse zone of different structure from the rest of the bone.

"Lovett divides bone lesions of rickets into three stages. As only the severe types of rickets call for differentiation from osteogenesis imperfecta and only from the late type of the latter, the author describes only the severe lesions, as noted by Lovett. In the first stage the epiphyses cast little or no shadow, while the center of ossification is small or absent and at times appears multiple. The diaphysis becomes frayed out, instead of clear cut, the periosteum thickened, and the whole joint appears hazy. Multiple fractures are common. This is the stage which is frequently classed as osteogenesis imperfecta. In the second stage the shadow of the epiphysis becomes more marked, the area is ragged and irregular, the ends of the diaphysis begin to broaden, especially on the side on which the strain is greater and here produces a ledge or lip next to the epiphyseal line. There is a thickening on the concave side of the shaft, which is a compensatory change. The diaphysis begins to give a more definite shadow. The ends next to the diaphysis are streaked longitudinally and are the area of maximum disturbance. At the epiphyseal end of the shaft there is generally a transverse area of increased density, reaching about a quarter or half an inch from the epiphyseal line. This continues into the third stage. Further changes in the second stage consist in the chambering of the interior of the bone, where light areas in the shaft indicate the absence of marked bone deposit, and heavier lines of ossification show the irregular development of trabeculæ. The second stage is generally a period of systemic reaction to the

disease, in which signs of returning ossification occur when deformity begins. In the third stage, the epiphysis begins to resume its normal contour and homogeneous shadow density. Irregularities persist in the marginal outline, and there is still a little mottling in the ossification. The lipping of the diaphyses has enlarged the bone ends, and there is in consequence a discrepancy in breadth between the diameters of the diaphysis near the epiphyseal line and the epiphysis.

"In infantile scurvy the most constant finding is an irregularly circumscribed shadow of varying diameter and intensity at the end of the diaphysis at the seat of new bone formation. This shadow, according to Rehn, enables one to make an early diagnosis of scurvy when all other classical clinical signs of scurvy are absent, provided it is possible to exclude congenital syphilis. Less constant than this shadow are the subperiosteal shadows at the seat of hemorrhages. These shadows may be invisible even at the height of hemorrhage, becoming more and more distinct with age, probably due to the deposit of osteophytes. Fractures and infractions are demonstrable in scurvy. Other findings in scurvy, which, however, are not always demonstrable by roentgen rays, are epiphyseal separation and displacements, hemorrhages within the joint capsule (considered to be very rare by Reyher) and occasionally, but rarely, intramuscular hemorrhages may be demonstrated. The clinical symptoms often enable one to make a diagnosis of scurvy and, according to Frangenheim, especially in older children a diagnostic triad makes diagnosis comparatively easy; (1) hemorrhagic diathesis, which is manifested by tendency to hemorrhages and multiple hemorrhages anywhere in the body, with its sequelæ, marked anemia; (2) severe pain in extremities accompanying every movement; (3) swelling of the joints. From these signs multiple subperiosteal hemorrhages are pathognomonic.

"In syphilis we must distinguish between the early congenital and the later bone changes. As to the diagnosis of syphilitic lesions of the bones, Fraenkel says: 'If in an infant in its first weeks of life we find roentgenologically at the epiphyseal line either homogeneous transverse shadow or a streak interrupted by lighter transverse streaks, the epiphyseal line being well outlined toward the diaphysis, and toward epiphysis a serrated ribbon-like shadow, we have a positive proof of existence of osteochondritis syphilitica.' In early congenital syphilis the entire skeletal system is affected, the long bones suffering chiefly. In later manifestations, in which periostitis ossificans is a very important finding, we see newly formed subperiosteal bony masses with bony structure. They are most marked in the middle of the diaphysis of the femur and less marked in other long bones. Old cortex may often be differentiated from the newly formed subperiosteal bony masses. Cortical thickening is therefore an important point in differential diagnosis from osteogenesis imperfecta, in which disease the cortex is always very thin. In the phalanges the epiphyseal line is somewhat lighter, the diaphysis is stronger and more compact and forms a dark, sharply circumscribed shadow. The phalanges are longer and thickened. There are definite changes in the exterior of the bone without any change in the interior, unless suppuration has taken place and other long bones of the body are similarly affected, which differentiates syphilitic dactylitis from tuberculous dactylitis. Fractures are comparatively rare in syphilitic infants.

"A characteristic of tuberculous lesions is primarily and definitely a destructive local process, without evidence of a tendency to bone stimulation. Osteogenesis, on the other hand, appears to be a general atrophy of all the bones of the body. In tuberculosis light shadows, due to bone destruction and calcium absorption, are seen surrounded by otherwise normal dark bone shadows, while in osteogenesis all the bones of the body show more uniformly increased permeability to roentgen rays. The neighboring bone areas show atrophy, the cortical substance is thinned and the spongy portion appears less dense, often giving a shadow of a density but little greater than the soft tissues. Callus formation in tuberculosis is very deficient. When tuberculosis affects joints, there is a high-grade atrophy and destruction of the bone. The bone ends show marked transparency. This increases the nearer it approaches the joint, thereby decreasing and often impairing the visibility of the joint contour. The entire region of the joint may become less visible. Comparison should be made with the well side, especially early in the disease, when diagnosis may be difficult. The tuberculous joint lesions and fractures are very painful, thus differing from

fractures of osteogenesis imperfecta, which seem to be attended with but little pain.

"Osteomyelitis presents an outline showing periosteal reaction in the form of proliferation of new bone about the necrosed area, or again the sequestra may be plainly visible. It is difficult to make a positive diagnosis before the second week. By the second week we have evidence of a more or less marked periosteal proliferation and new periosteal bone formation about the necrosed area. Light and irregular shadows at the seat of the bone involvement are also now visible, due to bone destruction. Later in the disease distinct bone sequestra surrounded by a definitely lighter shadow are characteristic."

In concluding the author points out the tendency of two of the cases under observation to develop secondary rachitic bone lesions. These rachitic changes led to a questionable diagnosis in these particular cases. However, a brief review of the changes characteristic of the two conditions tends to clear up the situation. The combination of the two conditions in the late form of the disease is the rule rather than the exception, while the early congenital type has not infrequently been described as fetal rickets.

"Most of the cases are sent into the wards as scorbutus, because of the pain at the seat of the fractures following motion of the extremities; the roentgenograms, however, readily show the cause of the pain.

"Segawa describes for the first time the combination of osteogenesis imperfecta as a congenital affection with Barlow's disease and rickets as acquired affections in an infant. The former was diagnosed clinically, the latter two only anatomically."

LOWMAN, C. L. Delayed Development in the Tarsus. (*Am. J. Orthop. Surg.*, Vol. XV, No. 6, June, 1917, p. 479.)

This article embodies the report of a case of a baby, aged 15 months, whose feet had always turned in and were getting worse. A diagnosis of absence of the tarsal bones was made and roentgenologically confirmed. As the child seemed to be backward in mental development, the author administered $\frac{1}{8}$ grain of thyroid twice daily, in addition to orthopedic treatment. A remarkable improvement followed both in the mental condition and the growth of bone, so that six months later the cuboid cou'd be seen in the roentgenogram and a faint beginning of what seemed to be the scaphoid on the right foot. The patient has since continued to improve in both directions.

The author, therefore, advises in cases where the feet have turned in since birth, not to be content with the assumption of simply "another case of congenital clubfoot," as it might be a case of delayed development.

In order to determine the relation of abnormal, delayed, or asymmetrical development of tarsal elements to subsequent deformity, he suggests more careful roentgen study of congenital clubfoot cases. He will, hereafter, attempt to have roentgenograms of all cases taken at uniform times: On first presentation of the case, at six months, one, two and three years. In this way it may be possible to discover some of the reasons for relapses, for persistency of deforming factors in the presence of good treatment and for continued overgrowth of one side of the foot at the expense of the other.

EHRENFRIED, ALBERT. Hereditary Deforming Chondrodysplasia. (*Am. J. Orthop. Surg.*, Vol. XV, No. 6, June, 1917, p. 464.)

The author attempts to lift this disease out of the class of uninteresting rarities by demonstrating that it is fairly common, by establishing it as a clinical entity, defining its manifestations, and by giving it a name which adequately describes its chief characteristics. He adds two more cases to his previous collection of twelve and illustrates one of them by six excellent roentgenograms.

Roentgenographic examination is absolutely necessary to make a diagnosis and especially to differentiate the condition from developmental or epiphyseal exostoses which are fairly common but little recognized. The latter group themselves particularly about the knee, but they may appear singly at other points such as the scapula and upper end of the shaft of the humerus. They are sometimes associated with a moderate deformation of the adjacent epiphyseal region, but they are never accompanied by the bony alterations and deformities characteristic of hereditary deforming chondrodysplasia. Whether heredity plays a part in their occurrence is not known. They develop during the period of skeletal growth and become stationary at skeletal maturity.

On the other hand, the roentgenograms of Ehrenfried's recent case of the hereditary form in a boy, 13 years of age, are described as follows:

Right arm.—Plateau-like hyperostosis on shaft of humerus; short ulna with irregular bulbous tip; bowed radius with an irregular and tilted epiphysis; potential manus vara.

Left arm.—Upper end of the humerus squared off; slight relative shortening of the ulna.

Wrists and hands.—Irregularities in bony structure of some of the phalanges; relative shortening of the right middle metacarpal; ulnar deviation of the last phalanx of the corresponding finger.

Pelvis.—The upper ends of the femora are broadened and irregular, and the necks are thick.

Left knee.—This shows the fractured exostosis due to accident, which brought the patient under the author's treatment.

After removal of fragment.—Both knees are shown illustrating the relative shortness of right fibula and apparent beginning fusion with tibia.

Lateral views of knee.—These show irregular contour of all the bones and fine stalactite exostoses on the femur, and vacuolated enlargement of upper end of right fibula.

From this description it is evident that roentgenograms of the entire skeleton should be made, in order to arrive at a correct differential diagnosis.

CASE, JAMES T. Comparison of the Operative and Radiotherapeutic Treatment of Uterine Myomas. (*Surg. Clin.*, Chicago, 1917, p. 579. *J. Surg. Gynec. & Obst.*, Vol. XXV, No. 6, December, 1917.)

The writer refers to previous papers in which he has presented evidence tending to show that the roentgen rays and the gamma rays of radium are practically identical, the choice being largely a matter of convenience in application. The article constitutes a contrast between radiation and operative treatment of uterine myomas, the contrast having been represented by one reviewer as follows:

1. Radiation, no mortality; operation 2 or 3 per cent.

2. Radiation, a certain remote danger of necrosis or malignant degeneration, which is absent after operation.

3. The discomfort of the patient from *roentgenkater* and the repeated treatments Case believes to be at least equal to, if not greater than, operative shock and recovery.

4. The possible mal-effect on the skin and the probable narrowing of the vagina (after radium) are placed against the operative scar, and possible hernia.

5. Ovaries completely destroyed by radiation and often completely, or at least partly, saved by operation.

6. Radiation must be rather general while, by operation, myomectomy is often possible.

7. And, as of rather more importance, Case considers the added probability of accurate diagnosis by open operation.

8. In conclusion, "only cases of uncomplicated intramural fibroids, or cases in which operation is declined or contraindicated by serious organic disease, should be subjected to ray treatment. Possibly there are some extremely neurotic individuals for whom the rays would also be preferable. The ray treatment should not be used when time is a factor, and it cannot be used with safety in rapidly growing tumors, in fibroids, complicating pregnancy, or where serious disease exists in the tubes or ovaries. The rays should never be used in any case where complete preliminary curettage with microscopic examination of the curettings is not feasible."

MEDICOLEGAL. Privileged Knowledge and Roentgenograms—Right to Se'ect Physicians. (Stapleton vs. Chicago B. & Q. R. Co. Neb. 162, N.W.R. 644. *J. Am. M. Ass.*, Vol. LXIX, No. 24, Dec. 15, 1917, p. 2065.)

The Supreme Court of Nebraska holds, in this personal injury case that when a party submits to an examination, or inspection, by a physician, for the purpose of learning the state of his health or the physical condition of any part of his anatomy, the knowledge thus acquired by the physician is privileged, and under Section 7898 of the Revised Statutes of Nebraska of 1913, the physician is not permitted to testify to the condition he found, over objection based on the statute. And when a plaintiff has permitted a physician to make a roentgenogram of his injured foot for the purpose of ascertaining the extent and character of his injuries, the roentgenogram so made is not admissible in

evidence over objection of the plaintiff based on the statute.

The court says that the statute cannot be given a strained construction, but must be taken in its plain and ordinary sense. When it says that a physician shall not be allowed to give testimony or to disclose confidential communications properly intrusted to him in his professional capacity, and necessary and proper to enable him to discharge the functions of his office, it means to exclude the disclosure of any information that comes to such physician by reason of the professional capacity in which he acts. It does not matter whether the patient seeks a prescription for a disordered stomach or a roentgenogram of an injured foot. Nor does the statute make any distinction between a regularly retained physician of a railroad company, and a physician paid by the patient. And the same rule which would exclude the oral testimony of the physician would exclude the roentgenogram of the plaintiff's foot. Its introduction in evidence would be a disclosure of a confidential communication.

The defendant complained because on cross-examination it was not permitted to inquire whether the plaintiff had submitted himself for examination to specialists for the purpose of qualifying them as witnesses, and whether he did not intend to produce these witnesses on the trial. This line of examination was not pertinent to anything developed in the examination in chief of the witness. He had the right to select his own physicians and his own witnesses. If counsel for the defendant disbelieved the testimony of the physician who testified as to the character and extent of the plaintiff's injuries, he might have procured the testimony of men eminent as physicians and surgeons by application to the court for the appointment of a commission to make an examination of the person of the plaintiff.

BERGER, A. Root Amputation, Its Principles and Indications. (*Dental Items of Interest*, March, 1917, p. 161.)

This article, while more or less technical and dealing with the side of the work of most interest to the operating dentist, nevertheless is important because it emphasizes the fact not sufficiently appreciated by many roentgenologists that apical abscess may often be successfully treated by root amputation without sacrificing the entire tooth.

BOGGS, RUSSELL H. Differential Roentgen Diagnosis in Bone Diseases. (*N. Y. Med. Jour.*, Vol. CV, No. 3, Jan. 20, 1917, p. 112.)

The object in presenting an abstract of this article is more to call special attention to it rather than to review the wealth of details it contains. It is one of those rare articles in which every word tells, the information given bearing the stamp of study, observation and experience not only of the affections themselves but also of the variety of roentgen shadows they produce. Full justice can not be done to such a description by a cursory summary; it ought to be studied in the original and inwardly digested so as to form the mental property of the reader.

Aside from giving due consideration to the precautions necessary to avoid misinterpretations in the shadows observed in bone affections, Boggs goes into particulars of the more common pathological conditions of the osseous system. He omits the rarer affections, such as osteomalacia, osteitis deformans, etc., since "the physician must be familiar with the roentgenological aspects of the common diseases before he is competent to differentiate between the rarer lesions," and it is on the latter, therefore, that he concentrates the reader's attention.

The affections thus discussed are dealt with in the following order:

(1) *Tuberculosis of the Bones and Joints.* — Attention is called to the importance of the clinical history, physical examination and other tests. The variations of the picture according to extent and age of the condition are duly considered.

(2) *Tuberculous Osteitis.* — The typical roentgenogram is described, with emphasis on the fact that this does not appear until the nutrition of the trabeculæ is interfered with. The differentiation from injury, typhoid spine, sarcoma and metastases secondary to carcinoma is dwelt upon.

(3) *Tuberculosis of the Hip-Joint.* — In this affection the youthful age of the patient furnishes different pictures from those in later life, where atrophy of the epiphyseal line of

the femur and acetabulum, and other skeletal changes, make their appearance.

(4) *Tuberculosis of the Knee in Children.* — As the starting point in this condition is of prime importance, the details for differentiating between them are explained.

(5) *Shoulder-Joint.* — Diagnostic points between tuberculosis, syphilis, rickets and scurvy are enumerated.

(6) *Osteomyelitis.* — In spite of the difficulty of roentgenologically detecting this affection in the early stage, a concise summary of the points to be considered in the various stages has been worked out by the author.

(7) *Sarcoma*, the most common form of bone tumors, can not be roentgenologically distinguished in the early stage from a simple inflammatory process. The changes occurring as the disease progresses and which can be roentgenologically visualized, are clearly described.

(8) *Periosteal Sarcoma.* — The guiding points are elucidated, although the author admits this to be the most difficult type to diagnose by the roentgen rays.

(9) The roentgenograms of *syphilis of the bone* are truly characteristic. Boggs describes these as well as the pictures of other bone affections, for which they should not be mistaken.

(10) *Myeloid sarcoma* must be differentiated from bone cyst, and the details are given how to succeed.

(11) *Carcinoma of the bone* is accorded a similarly careful analysis.

(12) *Carcinomatosis of the bone*, secondary to a growth in some epithelial organ, concludes this compact and highly instructive contribution.

Sommer, E. Roentgenological Studies of Callus. Suggestion of a Rational Treatment of Secondary Sequelæ after Fractures, etc. (Roentgen Taschenbuch, 1915, p. 7. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 158.)

Having examined a considerable number of roentgen plates, Sommer found that the ossification of the callus sets in two weeks after the injury.

In order to prevent muscular atrophy in the plaster jacket, Sommer proposes faradization by means of electrodes built in with the plaster jacket. It would then make little difference how long the jacket is allowed to remain in place.

Lord, Frederick L. The Newer Methods of Diagnostic Technic. (*Boston Med. and Surg. Jour.*, Sep. 6, 1917, p. 310.)

While admitting that to a certain degree diagnostic errors are unavoidable, Lord holds that they can be largely prevented by making more systematic use of the newer methods of diagnostic technic, among which he assigns a prominent place to roentgenological examination. He does not pretend to exhaust the subject but gives a very creditable survey over the possibilities within our reach.

Involvement of the paranasal sinuses and concealed pockets of pus about the teeth may be detected. The nature of lesions of mediastinum and lungs can be interpreted with much greater accuracy by adding a roentgenological examination to the clinical findings. It should be made an invariable rule to incorporate in the record all physical pulmonary findings before the plates are inspected, and then note any discrepancies between the two methods. It not infrequently happens that more is disclosed by the roentgen rays than by the physical method.

In abdominal cases roentgenology is of great assistance, but its findings should be judged in combination with the clinical features, if their utmost value is to be realized. Gastric abnormalities can by this means be demonstrated in practically all cases of carcinoma in its more advanced stages, while negative roentgen findings are of great value in excluding such lesions. The roentgenological differentiation between carcinoma and ulcer is often impossible. Carcinoma is not yet detected early enough to make the outlook for surgical interference hopeful except in rare instances. Peptic ulcer presents a high proportion of successful interpretations, but negative roentgen findings do not exclude ulcer. In the matter of gallstones the author holds no optimistic views, as in a large proportion of cases the diagnosis of cholelithiasis must still be made on the clinical features. But he admits that indirectly a roentgen examination is of value in helping to exclude peptic ulcer in a differential diagnosis with gallstones. Stone in the urinary tract, on the other hand, is shown in almost all cases, especially when an examination of the pelvic portions is included.

FRIEDLANDER, ALFRED. Enlargement of the Thymus Treated by the Roentgen Ray. (*Am. Jour. Dis. of Children.* July 17, 1917, p. 40.)

In this paper the facts are emphasized that the diagnosis of enlarged thymus can be definitely made by a simple physical examination, aided by the roentgen ray, and that in the latter we possess a therapeutic agent which will effect a cure in the vast majority of cases. After detailing the physical signs and symptoms, the author states that definite information as to the existence of the enlargement is afforded by the roentgen ray, provided that certain technical requirements are fulfilled. These, with special consideration of the examination of young children, have been laid down by Sidney Lange as follows:

"The child is placed flat on the back. The slightest lateral tilting produces on the roentgen plate an asymmetry of the two halves of the chest and a 'flopping' or displacement of the mediastinal and heart shadows to one or the other side. Repeated trials must be made until a plate is produced which shows the chest areas, i.e., the distances from the midline of the spine to axillary borders of the ribs, to be equal on right and left sides. Under these conditions, enlargements of the upper mediastinal shadow, whether to the right or to the left of the midline, can be readily recognized. It is essential in very young children that the exposure be almost instantaneous. If the time exceeds one-thirtieth of a second, blurring will result. A very soft tube should be used, as the delicate thymus tissue will fail to cast a shadow if the quality of the ray be too hard or penetrating."

The normal roentgen shadow is a median one, resting on and continuous with the heart shadow. Marked enlargement of this shadow, especially lateral enlargement, is characteristic of hypertrophied thymus. There is no difficulty, as a rule, in differentiating the shadow produced by enlarged thymus from that produced by congenital heart lesions or caseous lymph nodes. A broadening of the shadow to the right may at times be due to large vessels, especially the vena cava superior. But this can not hold good when the larger part of the shadow falls to the left of the vertebral column.

Enlarged bronchial glands give an extra median shadow separate from the heart shadow and not connected with it.

In doubtful cases, where symptoms of thymic asthma appear without clearly demonstrable physical signs, roentgen treatment given as a therapeutic test will often clear the diagnosis.

The technic of the treatment, as worked out by Lange, is as follows:

A Coolidge tube, backing up a 9½-inch spark gap and a filter consisting of 4 mm aluminum and a piece of thick leather were employed. The target-skin distance was 9 inches; the routine exposure 25 milliampereminutes. In mild cases a single dose given over the anterior surface of the chest proved sufficient. In more urgent cases 50 milliampereminutes were administered at the first treatment, 25 anteriorly and 25 posteriorly. Sandbags were placed across the arms and legs. The treatments proved entirely harmless to young children, but should be comparatively heavy and repeated at sufficiently short intervals. Failure to administer full doses and to repeat them promptly has in very urgent cases led to fatalities under roentgen treatment. To guard against such disasters, all patients with urgent symptoms should be kept under close observation and the roentgen treatments should be pushed boldly.

In the average case improvement of symptoms has been noted within twenty-four to forty-eight hours.

FOOTE, EDWARD M. The Place of Radium in Surgery. (*Annals of Surgery*, Vol. LXV, No. 3, March, 1917, p. 273.)

The value of radium in replacing the knife in cancer operations has, according to Dr. Foote, not yet been fixed with any degree of definiteness. There are extremists in both directions, and the author has set himself the task of curbing vaulting ambition on the one hand and counteracting undue pessimism on the other. He does not go into the details of technic and holds that even the dosage must rest with those who use it according to the individual case, but he enjoys "the humor of the situation when the possessors of a hundred milligrams or more of the element object to treatment being made by the men who have only ten or twenty milligrams, on the ground that small quantities do more harm than good on account of their stimulating effect; and when the owners of the small amounts publish

striking successes." In a happy strain, Foote suggests if for no other reasons than the interests of veracity, that the owners of radium should be officially registered together with the quantity of radium they possess.

Dealing with the vexed question of deciding when radium has effected a cure, the author demands further experience to definitely determine to what depth tumor cells have been influenced beyond the possibility of regrowth. The microscope may still reveal islands of cancer cells in apparently cured cases, but their mere presence is no proof of whether they are dead or only dormant.

The question as to what kinds of tumors are susceptible to the influence of radium, elicits different answers by nearly every writer, but it is generally admitted that surface or near-surface growths, such as keloids, lymphangiomata and basal-celled epitheliomata in very early stages will disappear under radium treatment. Isolated instances of almost every kind of tumor have been published with claims of cure, but "thus far no rule has been discovered by which the effect of radium in any particular case can be predicted with certainty." The effect on sarcoma, though more favorable than on any other kind of tumor, is very variable—probably from the same unexplainable reason that, while one sarcoma will destroy the human body another is driven out by some apparently inadequate cause, Coley's fluid, for instance.

Prickle-celled epithelioma, which the author places next in the favorable list, offers more resistance probably due to its vitality or tendency to rapid growth away from the surface. A favorable effect of radium on other tumors is claimed by some, and denied by others. Without committing himself over these disputes, Foote thinks it a little far-fetched to explain the disappearance of cancer of the cervix and much more so of the body of the uterus as due to artificial sterility produced by radium treatment of fibroids, for the reason that no such phenomenon takes place in the normal menopause. He rather endorses the conservative view of Ransohoff who advises operation in uterine cases but uses radium to stop the discharge and hemorrhage, incidentally destroying any cauliflower masses that may develop. At the same time he has found that any resulting improvement of symptoms is in most cases only temporary.

The author also considers it unlikely that secondary cancer nodules anywhere can be cured by radium, as its influence lower than one inch from the surface is said to be practically nil. He offers three possible explanations for the reported disappearance of cancer when lymphatic glands were involved. His first point is that lymph glands are often enlarged from other causes; the second point is that ulcerative cancers often produce enlargement of the regional glands without infecting them; and the third possibility is that even non-ulcerating cancers may produce glandular enlargement by irritation. It is therefore not safe to assume that radium has cured metastases, unless at least one gland was previously removed and found to be cancerous.

What Foote considers perhaps the most important question is whether operable cancer should be treated by radium. Weighing the evidence in the light of the published literature, he concludes that a patient is done a grave injustice by having radium advised for a primary prickle-celled epithelioma or for any primary cancer of considerable bulk, if the conditions are favorable for surgical removal. In rapidly growing tumors so situated that operation is likely to prove unsuccessful, radium may be tried, but the proper place to test it is in the recurrences. Primary basal-celled epithelioma of the face, lymphangiomata, uterine fibroids, angiomata and keloids may be safely treated with radium.

Summing up his experience, the author concludes:

"When the investigator in radium becomes so expert that he can say with definiteness, 'Here is such and such a type of tumor and its bulk is approximately so and so; I know from experience that I can cause its entire disappearance with so much radium applied for so many hours,' it will be time enough to advise radium in primary operable cases."

RÉCHOU: Roentgenotherapy of War Wounds. (*Jour. Radiol. et Electrol.*, Paris, May–June, 1917. Ref. *Jour. Am. Med. Assoc.*, Sep. 25, 1917, p. 1035.)

Réchou describes the efficacy of roentgen rays in modifying the fibrous connective tissue which forms around nerves after a war wound, facilitating the absorption of the newly formed

exogenous sclerosis, as Hesnard calls it. This connective tissue proliferating around the nerves binds it to adjacent organs, and mischief follows. The rays seem to disintegrate this newly formed tissue, while the nerve tissue does not seem to be influenced by the rays in doses just sufficient to accomplish this. He has found most effectual a monthly large dose, 10 or 12 H units, under an aluminum filter with cross-fire application, if possible. He reports the details of seven cases, in which the neuroma, contracture of the biceps and of the fingers, and the reaction of degeneration and atrophy of the muscles subsided in two or three months, or were materially improved. In a group of five other cases the cicatrix after a war wound was adherent and interfered with functioning. The use of the limb was regained more or less completely after a few exposures. Keloid and painful cicatrices were also favorably modified. Neuritis and even ankylosis may show marked improvement. In the discussion that followed, Beaujard reported over 66 per cent. cured and over twenty-three improved in ninety-three cases of crippling or painful wounds and all but 20 per cent. cured or improved in fifteen cases of troublesome neuromas, while all were cured of the ten patients with typical causalgia. All but 21.5 per cent. were cured or improved in fourteen cases of cicatricial compression of a nerve and in both of two cases in which the spinal cord was thus compressed. Laquerrière described the fine results obtained in a number of cases of infiltration and inflammation of tendon sheaths, also as an adjuvant in old hydrarthosis. The speakers emphasized that their remarks applied exclusively to war conditions, and that the rays were most effectual with young cicatricial tissue.

Roch, C. Mechanical Switching Device for Roentgen Tubes. (*Paris Médical*, Vol. 7, No. 4, Jan. 27, 1917.)

The inconvenience and loss of time experienced over carrying out the roentgenologist's orders to an assistant for handling the switches has been apparently overcome to some extent by Roch. He has devised a small apparatus consisting of a lever and a pear-shaped rubber bulb which is so arranged that two currents can be alternately c'osed or opened. When at rest, the lever closes the lighting circuit and opens the primary circuit of the high tension transformer. A quick, short squeeze of the bulb changes the position of the lever, so that the current is conducted into the roentgen tube, cutting off the lighting circuit. When the roentgenoscopic examination is over, another pressure on the bulb interrupts the communication with the tube and re-establishes the lighting connection. The apparatus is always ready for use and may be either hung up with the regular equipment or fixed at the operator's gown; it may be carried in the hand or placed on the floor to be operated with the foot. It is manufactured by Croullebas & Mottier, 8 rue de Maistre, Paris, France.

Young, Hugh H. The Use of Radium in Cancer of the Prostate and Bladder. (*Journal of the A. M. A.*, Vol. LXVIII, No. 16, April 21, 1917, p. 1174.)

The author presents a number of new instruments and new methods of application of radium in cancer of the bladder and prostate. The instruments are masterpieces of ingenuity. The article is replete with technical details which it is hardly possible to abstract. Dr. Young began his work timidly and cautiously, being fearful of burns from short ureteral or rectal treatments. The methods described in the article were evolved slowly, step by step, after he had demonstrated that by exact methods it was possible to place radium where he willed and to change its location sufficiently often to avoid injury to normal adjacent, intervening or remote structures. Astonishing results have been obtained in some cases: disappearance of obstruction, shrinkage and great softening of certain cancers of the prostate, and extensive retrogressive changes in inoperable cancers of the bladder. Fairly large amounts of radium, in high concentration, are desirable in order to make the treatments, amounting to 2 or more milligram-hours of as short duration as possible. This is particularly true of cancers of the bladder, in which the patient is often intolerant of long treatments.

While the author does not venture any statements as to the possibility of cure, he is sure that large relief can be afforded.

BAILEY, HAROLD. The Use of Radium in Gynecological Diseases. (The *American Journal of Obstetrics*, Vol. LXXV, Whole No. 472, p. 556.)

The author is convinced that radium has a place in gynecological treatment and that it will no doubt fill a much larger field when the technic has become standardized. If scientific advancement is to be expected, enthusiastic reports must hereafter be accompanied by a complete history of the physical findings together with the histopathological report and all the details of the technic. Prophecies are out of place.

Histological proof is at hand that carcinoma cells may be destroyed by radium; also that this action even after tremendous doses of radioactive substance does not extend much if any more than 3 cm into the tissue. If this were the whole story no one could doubt that the proper treatment of the beginning cancers of the cervical lip would be radiation, but in order to apply an amount of radium sufficient to insure the destruction of the cells in such a case, severe radiation of normal parts must occur and the resultant damage cannot be looked upon lightly. Stricture of the rectum and rectovaginal and vesicovaginal fistulæ have been reported too many times (and there are probably many cases that have not been reported) from our leading clinics for us to accept offhand the statement that radium can be used without local or general injury to the patient.

The question arises: Could not a moderate dose of the radium be used as a preoperative treatment to destroy or prevent the reproduction of the cancer cells? Bumm, Wertheim, Kelly and a number of others state that the radical operation is made more difficult by the infiltration, hyperemia and sclerosis of the pelvic connective tissue. Whether this induration in the pelvis will prohibit the attempt at removal, time only will decide; so far it has not. It would seem that in this field lies the great future of radium—preoperative treatment.

The knowledge of the pathology and the dissemination through the lymph channels of the cancer cells and the uncertain action with the entire lack of standardization of the radium treatment, of necessity, causes us to uphold the dictum that radical excision must be the treatment for every operable cancer of the cervix.

Cancer of the Fundus.—Statistics show a 70 per cent. cure of this disease by operation. Radium could be used as a preoperative measure, for the uterine muscle acts as a filter for the damaging hard beta and secondary beta rays. The condition within the uterus and in the broad ligaments must be unknown and the cessation of hemorrhage and discharge is no indication that the patient is cured. Here as in the former type of the disease operation must be performed.

Inoperable Cancer of the Cervix and Borderline Cases.—Radiation, radium and *x*-ray have a valuable field. Palliation will occur in many cases and in a few temporary cure. The outlook is good for a number of permanent cures in this group. In recurrent cancer the results have not been encouraging. We must always have before us Kelly and Burnham's 28 per cent., and Schmitz's 35 per cent. of clinical cures in this class and live in the hope that these results may be duplicated. The opinion of Clark that in those cases in the inoperable class which respond to the treatment it is better to leave well enough alone and not attempt to operate later, seems well founded.

Treatment of Fibroids.—In a paper on the operative treatment of fibromyomatous uterine tumors, John B. Deaver says: "A patient treated by radium even though symptomatically improved, still has her fibroid, for I do not take seriously the claim that such tumors disappear under the influence of radiations. Also is it not time for the profession to take a stand and condemn the excessive zeal of those who would displace operation or relegate it to a last resort, and instead put radium in its proper place as a symptomatic treatment to be employed only when operation is contraindicated."

Most operators will find that the indications outlined by Frank for the *x*-ray treatment of fibroids will also apply to the use of radium. Cases with serious heart, lung or renal disease or those who refuse operation providing the tumor is uncomplicated and not too great a size, might be selected for the ray treatment.

BOOK REVIEWS

NOTES ON MILITARY ORTHOPÆDICS. By Colonel Sir Robert Jones, C.B., Inspector of Military Orthopædics, Army Medical Service; with an introductory note by Surgeon-General Sir Alfred Keogh, G.C.B., Director-General, Army Medical Service. 128 illustrations. Paul B. Hoeber, 67 East 59th Street, New York. $1.50.

This little book is of genuine value because it is the outcome of an immense experience in dealing with the increasing problems of the disabled soldier. The style is one of marked simplicity, brevity and military directness.

For instance, in discussing fractures about the elbow joint, Colonel Jones says, "The limb should therefore be extended to push away any fragments likely to obstruct extension afterward. The forearm should be supinated to make sure of clearing a right of way in that direction, and then the elbow should be fully flexed and bandaged." This laconic disposition of a surgical problem is characteristic of this wonderful primer.

The title, Military Orthopædics, acquires meaning when you become familiar with the burden of derelict human bodies which have been invalided home from the front and placed in orthopedic centers in England, with Robert Jones at the head of the work. Curative workshops, they should be called.

Instead of the monotonous movement with mechanical apparatus of the "boche" Zander type, a man with stiff ankles is set to drive treadle, lathe or foot saw. Men with stiff hands and fingers are given big swabs to clean windows or a paint brush to handle.

This book, though small, covers a wide range of new orthopedic thought, made necessary by new military conditions. There is a fine chapter upon "The soldier's foot; flat foot, claw foot, hallux rigidus, valgus, hammer-toe, metatarsalgia, painful heel, spurs, etc." When you see that 34 pages out of 130 are taken up with the discussion of the soldier's foot, you realize how important the subject is.

We do not consider that the military surgeon alone will be interested in this book. It is of equal value to the civilian practitioner. There are chapters as follows:

1. Positions of Election for Ankylosis following Gun-shot Injuries of Joints.
2. Suture of Nerves and Alternative Methods of treatment by Transplanting of Tendon.
3. The Soldier's Foot and the Treatment of Common Deformities of the Foot.
4. Malunited and Ununited Fractures.
5. Transplantion of Bone, and some uses of the Bone Graft.
6. Disabilities of the Knee Joint.
7. The Mechanical Treatment of Fractures under War Conditions.

The book reflects the judgment of the most thoroughly experienced orthopedist in the English-speaking world. Thousands have been sent home to be made over into earning civilian units who will be able to help themselves instead of being pension barnacles upon society, because of this man's work and this extraordinary book.

E. H. S.

RADIUM THERAPY IN CANCER. At The Memorial Hospital, New York. (First Report, 1915–1916) by Henry H. Janeway, M.D., with a discussion of Treatment of Cancer of the Bladder and Prostate by Benjamin S. Barringer, M.D., and an introduction upon the Physics of Radium by Gioacchino Failla, E.E., A.M. Paul B. Hoeber, New York, Publisher. 1917. Price $2.25 net.

This is a very satisfying book, especially to one working with radium. Of course, the pages contain reports of many remarkable results, which will interest many surgeons, notwithstanding the difficulty of convincing them that other agents besides the knife may possibly be helpful in the fight upon malignancy. But we may be sure that this report upon Radium Therapy at the Memorial Hospital during 1915–16 will be eagerly read by the many purchasers of small amounts of radium—25 to 50 milligrams.

Not that there has not been sufficient radium literature but it has been inefficient. The radium articles in the current medical press have been upon the order of pot-boilers, which this book decidedly is not.

This report covers 237 pages and is divided into three parts. The first by Gioacchino Failla, a physicist, undertakes to describe "Physical Considerations Relative to the Application of Radium." All of which appears

quite formidable. But it is all necessary to the radium therapist. Just as necessary as a knowledge of gastric physiology is to the thinking successful abdominal surgeon.

Dr. Henry H. Janeway contributes the second part upon "Radium Therapy in Cancer." He relates principles and methods of applying radium at the Memorial Hospital, showing numerous new and ingenious applicators and then proceeds to the report of the results at the Memorial Hospital in carcinoma in the various and usual sites. Naturally, this makes up the bulk of the report, but it is not tiresome as frank comment is woven into and between the case histories.

The third part is upon "Radium Treatment of Bladder and Prostatic Carcinoma" by Dr. B. S. Barringer. There are only ten pages but they are wonderfully illuminating.

Every radium therapist will welcome this book and the publisher is to be congratulated upon his temerity in undertaking to give it wider circulation with little hope of financial reward. This report is so different from certain ambiguous super-heated reports from other renowned and orthodox sources, that it will probably pass with little attention, because it is too modest. Diogenes! Awake Ye need not travel further! Here are three honest authors! E. H. S.

INTERNATIONAL CLINICS. Vol. II, 27th Series, 1917. J. B. Lippincott Company, Publishers, Philadelphia.

This number of the CLINICS contains a valuable article by Henry A. Christian on "Gout and Infectious Arthritis." Numerous illustrations are appended, chosen from the collection in the Roentgen Department of the Peter Bent Brigham Hospital, and although no new roentgenological points are brought out, it will pay every roentgenologist to study the article in its details.

The article by James J. Walsh on "Constipation and Natural Food" makes very interesting reading.

Another article of interest to roentgenologists is by Arthur F. Hurst (well and better known to readers of this journal as Arthur F. Hertz of London, *ante bellum*) on "Mucomembranous Colitis." The clinical aspects of the subject are well treated, but the reviewer regrets that no reference has been made to roentgenological examination, as he has found the latter a valuable adjunct in the differential diagnosis.

The Surgical Clinic of the Presbyterian Hospital by John Speese and P. G. Skillern, Jr., contains, among other interesting case reports, one case of unusual interest, in which a diverticulum of the stomach was diagnosed upon roentgenological findings. Unfortunately, the patient declined surgical help, so that the diagnosis could not be operatively confirmed. Antisyphilitic treatment relieved the pain and distress, greatly improving the patient's condition. It would have been a matter of the highest interest to have had an operative check upon this case.

It is a commendable fact that medical journals of a general trend feel increasingly inclined to acquaint their readers with the progress of roentgen rays and radium. Thus, the May number of *Southwestern Medicine* has no less than three articles dealing with that subject: the first, by W. W. Wilkinson, on "Roentgen Therapy"; the second, by George E. Bushnell, entitled "Extension of Tuberculosis of the Lungs as Shown by the X-Ray"; and the third, by Rex Duncan, which is devoted to "Radium: Its Properties, Action and Local Application as a Therapeutic Agent." The articles do not contain any new research work or discovery, but serve to familiarize the general practitioner with the achievements of radium and the roentgen rays and as such are a welcome addition to the literature.